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november, 1948

the tech engineering news

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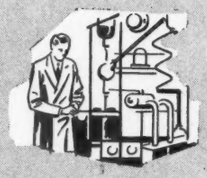
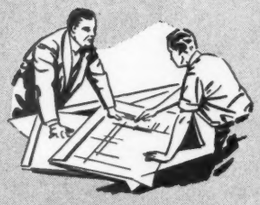
YOU CAN BE SURE... IF IT'S Westinghouse

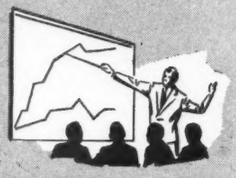
YOUR BIGGEST QUESTION



RESEARCH?



ENGINEERING?



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"Where shall I begin my career in industry to attain the highest degree of success?"

Probably this question has been running through *your* mind in recent months.

To help you answer it—and bridge the gap between your college training and a successful career in industry—Westinghouse offers the Graduate Student Training Course. This program, in operation for over fifty years, has provided practical training for over 15,000 engineering graduates. Its objectives are:

1. To show how your college training can best be applied to industry.
2. To help you find the type of work you like best and for which you are best fitted; the right man in the right job is of permanent benefit both to you and to us.
3. To give you an understanding of Westinghouse—its products, operations and many avenues of opportunity.

These objectives are realized through basic training in industrial methods and organization, plus actual job assignments to prepare the way for future responsibilities. Proof of the practical value of this course lies in the fact that the majority of key positions in Westinghouse are occupied by graduates of this course. G-10024

Investigate the opportunities open to you at Westinghouse—begin planning your future today. Send for your free copy of the booklet, "Finding Your Place in Industry".

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The skeleton where Volts are Housebroken

. . . with the help of
Alcoa Aluminum Structural Shapes

Electricity is transmitted in raging, sizzling, high-tension currents that couldn't be allowed to enter a home or factory. To "housebreak" this hot stuff—step it down toward a useful 110 or 220-volt distribution stature—is the job of substations.

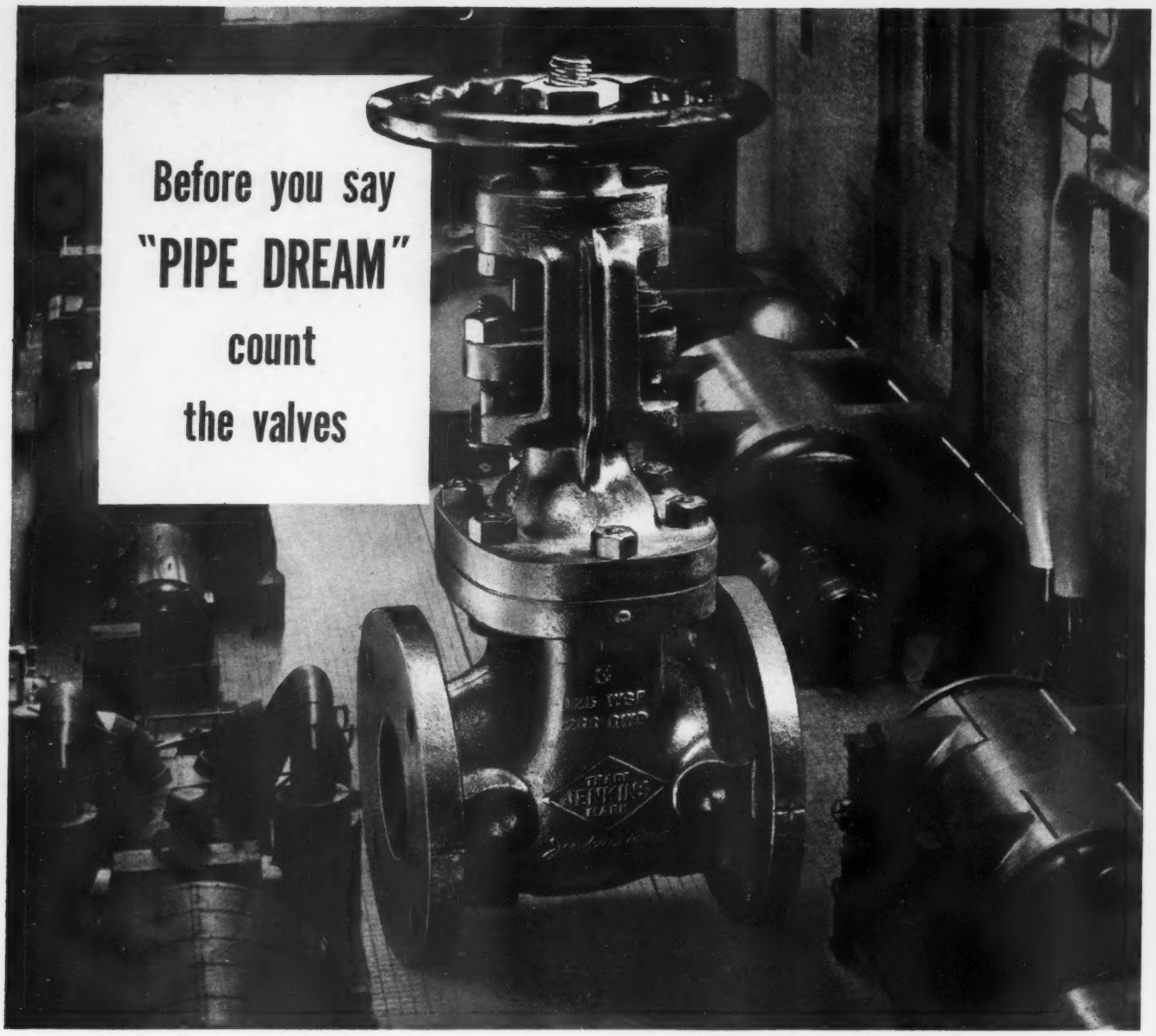
The "skeleton" of each substation—the framework of beams and girders that support the transformers and equipment—is prey to weather, corrosive atmosphere, clinging dirt. Good maintenance has always called for frequent painting, and that called for shutdowns of electricity . . . until substation builders heard about Alcoa Aluminum Structural Shapes! Now the skeleton of a substation can be built, and routine maintenance painting forgotten. Among the standard shapes made by Alcoa, engineers find sections exactly suited to their needs.

It gives a whole new concept to structures—this building with Alcoa Aluminum Shapes. When they are used for bridges, railroad enginehouses, industrial equipment and similar structures, damaging red rust will never be a menace, painters will be freed from their frequent rounds! That's something to remember when you start putting your degree to work and are designing structures for industry instead of for grades. ALUMINUM COMPANY OF AMERICA, Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA FIRST IN **ALUMINUM**

ALCOA 1888 1948 60 YEARS OF SERVICE

60 years ago aluminum was a novelty metal, used only for trinkets such as combs, watch fobs and napkin rings. Then along came a little company with two ideas firmly in mind—making aluminum *cheaper* and *better* so it could be more useful. That was the start of Alcoa, the start toward making aluminum so strong that it can often replace structural steel. Alcoa's 60 years of research and engineering development have swelled the uses of aluminum from a handful of trinkets to 4,000 different applications in industry, in homes, and on farms.



THINK OF *all* the valves in this power plant as *one* valve, and your mind's eye will see something like this photo-illusion. It emphasizes an important fact—that valves, collectively, are a major investment in *any* plant, *any* commercial or institutional building.

WITH WAGES and material costs the highest ever, it is just as important for alert management to keep a sharp eye on valve maintenance costs as it is to watch operating expense of larger plant units.

EXCESSIVE MAINTENANCE of one inferior valve is insignificant, but multiplied by thousands, it is a serious drain on operating budgets. JENKINS BROS. helps to meet this problem two ways. First, by building extra endurance into Jenkins Valves, making them the longest-lasting, lowest-upkeep valves that money can buy. Second, with advice from Jenkins Engineers on any question of proper selection, installation, or maintenance.

That's why, for all new installations, for all replacements, progressive management relies on Jenkins quality and engineering for lowest valve costs in the long run. Sold through leading Industrial Distributors.

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"PREVENT VALVE FAILURE" is a 28-page guide to valve economy, fully illustrated, with case histories of valve damage, and recommendations for its prevention by proper selection, installation, inspection, and maintenance. FREE on request. Write: JENKINS BROS., 80 White St., New York 13, N. Y.

LOOK FOR THIS JENKINS DIAMOND MARK
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THE SALESMAN WHO CARRIED A GLASS PIPE !

"LOOK AT THIS, Mr. Irvin!" said Joe the salesman as he whisked a short length of glass pipe out of his briefcase.

"This is one reason why our food products are pure and clean. Right up to final inspection, they flow through Pyrex glass piping. We can see them all the time!

"We can keep the pipes clean easily without taking them down. And when they're clean, we can see they're clean. And what's more, food and fruit acids don't attack glass, so there's no danger of spoiling the taste!"

Glass pipe to guard the purity and quality of your product is only one of 37,000 things we make at Corning Glass Works.

We make the glass bowls for five best-selling coffee makers. We know the answers to a lot of questions about television because Corning has been making the glass parts for television from the start. And if you sold housewares, we could help you attract new customers with our Pyrex Flameware Double Boiler, made of the first glass ever specially developed to stand the extra shock of top-of-stove cooking.

In nearly a hundred years we've found ways to make 50,000 different kinds of glass. Some of them may someday help you improve production or cut costs. Others may suggest ways to make your product more desirable or useful to the people who buy it. Remember us when that day comes. Corning Glass Works, Corning, N. Y.

IN PYREX WARE AND OTHER CONSUMER, TECHNICAL AND ELECTRICAL PRODUCTS ▸

CORNING
means
Research in Glass

GRINNELL PROTECTION WOULD HAVE PREVENTED THIS

After the fire, what can he tell *THEM...?*

NATURALLY THE OWNER IS THE BIG LOSER when his business burns.

But if people have trusted him and have left managerial judgment up to him, he will find that he has to answer not only to himself but to a whole community if he has been lax about fire control.

For instance, what can he say to the fire chief, one of whose men was seriously injured in the fire? He has been warned repeatedly that, although buildings may be fireproof, the contents may be virtually tinder.

How would he answer his cashier who has told him time and again that an indemnity check will not cover re-building costs at today's advanced prices? Or that statistically 2 out of 5 businesses with records destroyed by fire never get started again.

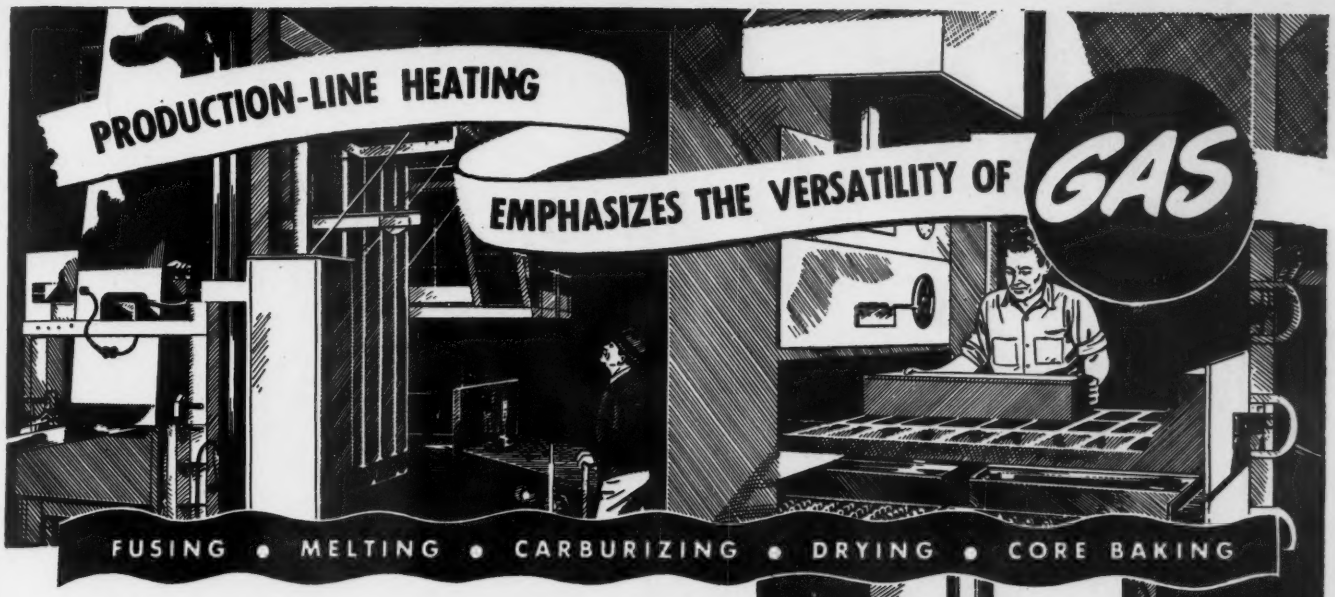
How would he explain to the skilled men who have helped him build his business and now must, for their families' sakes, go elsewhere and get established again?

THERE IS ONLY ONE ANSWER: He must be prepared for fire before it strikes. He can *never* hope to prevent fire from starting. But he *can* be prepared to prevent fire from causing material damage. He *can* successfully control fire, whenever and wherever it strikes, night or day, without fail, through Grinnell Protection by automatic sprinklers. Competent authorities will attest that Grinnell Protection by automatic sprinklers is the surest way. In addition, Grinnell Protection usually pays for itself in reduced insurance premiums in a few years. So, if his property is insured, he is paying for Grinnell Protection. . . . *Why not have it?* Grinnell Company, Inc., Providence 1, R. I. Branch offices in Principal Cities.

GRINNELL

AUTOMATIC SPRINKLER AND SPECIAL HAZARD FIRE PROTECTION

ENGINEERING GRADUATES HAVE FOUND ATTRACTIVE OPPORTUNITIES WITH GRINNELL

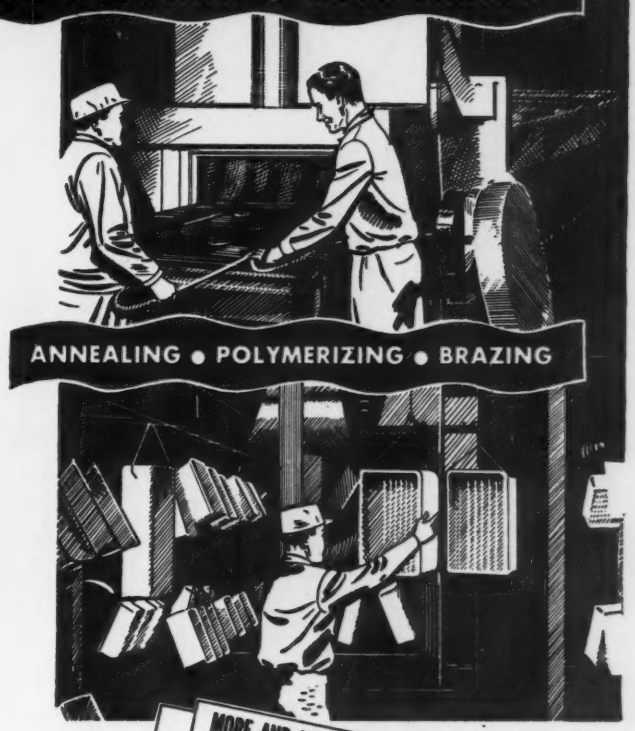


These are the tasks for GAS—these and hundreds of other industrial heat processing requirements. In fact, modern Gas Equipment has proved its superiority in virtually every industrial production-line heating application.

As a source of heat in the production and fabrication of metals GAS combines characteristics found in no other available fuel—

- **SPEED**—heat can be applied to any area or injected to any depth at exactly the temperature and speed desired.
- **CONTROLLABILITY**—automatic controls maintain precise temperatures, permit exacting cycles of heat processing on continuous 24-hour schedules.
- **FLEXIBILITY**—equipment is applicable over a wide range, performs many heat-treating and processing operations without expensive accessory devices.
- **ECONOMY**—the fuel and the modern equipment are economical, the production cost per piece amazingly low.
- **CLEANLINESS**—clean fuel facilitates good "shop housekeeping," promotes morale and good health among workers, eliminates many causes of rejects.

These are the characteristics of GAS you'll find useful in any industrial heating application—these are the reasons why GAS is Universally accepted wherever heat is used for processing.



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FOR ALL INDUSTRIAL HEATING

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REVEALED IN ITS
OF RADIATION
AT LAST SEEM

the tech engineering news

November 1948
Vol. XXX No. 1

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MEMBER OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED

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from the editor's notebook

Probably the best qualified to write on the subject, **Earl W. Eames, Jr.,** has produced for *T. E. N.* the descriptive article about the Foreign Student Summer Project featured in this issue. Apart from his chairmanship of the F. S. S. P., Earl has held the chair of the N. S. A. committee, office in the Tech student government, and is a member of the editorial board of *The Tech.* He entered Tech after four years of service as a Radar Officer in the Navy and is a member of the Class of '49.

Marc Alfandry, author of "Middle East Jig-Saw Puzzle," is a regular contributor to *T. E. N.*'s columns. After delving into various questions of interest to his field, Chem Engineering, he has come up this time with an article for which he should have enough background. Marc was born on Egyptian soil — Cairo to be exact. Always interested in the economic and engineering aspects of industry, Marc already has a degree in economics.

Unless you read the fine print below photographs or else the masthead of this magazine, you probably don't know of **Dan Sully's** connection with *T. E. N.* Officially, Dan is *T. E. N.*'s chief photographer; unofficially he does practically anything else around the office. One of the Course XV-A boys,he joined the staff as a freshman from Brooklyn Tech. Now, as a sophomore, he complains that the staff borrows most of its pictures, instead of having him take them. His pictures of Frosh Camp illustrate what he does when he gets the chance. He is also ticketed for a forthcoming article on photo-lithography.

Another Course XV sophomore, **Jerry Levine,** has contributed to this issue the story, "Wood for Thought." This is his second contribution since he arrived at Tech from the High School and College of the University of Chicago. Writing is just up his alley, since he was feature editor of his high school paper.

Robert J. Vidal's second contribution to the pages of *T. E. N.* has taken form as "axe grinding" for his favorite course, XVI, and his favorite topic, aviation. "That Wild Blue Yonder" was preceded by an article on the D. I. C. last spring, but Bob favors aviation and before many more issues go to press will probably write about another interesting phase of aeronautics.

What we like to see around *T. E. N.* is an eager author. One dropped in not long ago and laid a timely article, complete in every respect, right on our desk. Eagerly we grabbed at it and published it. **Fred Diamond's** article on the "transistor" is only slightly out of his line. A modest Course VI junior from Staten Island, Fred is taking up the E. E. power option. This issue's contribution is his first to the *T. E. N.* cause.

foreign student summer project—m. i. t.

By Earl W. Eames, '49
(Chairman, M. I. T. F. S. S. P. Committee)

This summary of the project starts off the series of eight articles written by the European F. S. S. P. students who were here this summer.

Beginning as an idea that students should be able to play their part in the educational reconstruction and rehabilitation of Europe, the M. I. T. Foreign Student Summer Project has developed into a program which has gone far beyond the rehabilitation aspects to a stage where it may truly be called "a new experiment in international relations."

In May, 1947, toward the end of the school year, we students active in the National Student Association Committee at M. I. T., most of whom had seen and participated in the destruction of Europe in World War II, and all of whom were aware of their obligation to students in the war-torn countries, decided that we would attempt to invite science and engineering students for a course during the summer of 1948.

After giving careful consideration to the plan, we presented our idea to the Constitutional Convention of the National Student Association, a federation of student governments representing hundreds of universities and colleges throughout our country, and obtained unanimous approval. When we returned to school in September, 1947, we went to Dr. Karl T. Compton, President of M. I. T., and presented our plan to him, asking for his help in bringing a maximum of eighty students to Tech for the summer. He was immediately enthusiastic and offered his complete cooperation, at the same time telling us that since this was a student project he felt it should be organized and run by students. We are very pleased to say that the Project has always remained a student program, with the utmost cooperation and assistance from administration and faculty whenever such help was requested. Dr. Compton told us he would place the matter before the Executive Committee of the Corporation with a request for it to waive the tuition payment for eighty students. This request was soon granted and our expenses were greatly reduced.

We then discussed the Project with members of our student governing body, the Institute Committee, and were given authority to form a Project Committee under our N. S. A. Committee together with funds for the initiation of such a plan.

By November 1, a committee of twenty began consideration of the real problems involved in the Project, and they were many. We had first to decide the details of selection; fund raising needed careful consideration; plans for publicizing the Project had to be worked out.

The first problem we settled was what criteria we should use in selection and how students were to be chosen. We decided to invite between sixty and eighty graduate students in science and engineering from all war-devastated countries, whether former enemy or ally, and with no regard for politics, religion, or race. They would have to have a good knowledge of English, and would be chosen both on their academic record and their extra-curricular activities.

The actual selection of the students overseas was

Earl Eames, Project chairman, points the way. *New York Times*

Students from Finland to Italy view the new Hancock building. *John Hancock Mutual Life Insurance Company*

First ice cream in many years.
New York Times

a large problem which was solved to our complete satisfaction. Through the cooperation of the International Student Service and the Division of the International Exchange of Persons of the United States Department of State (I. E. P.), screening committees were set up in most of the countries concerned to distribute information and applications, to interview and screen all of the applicants, and to send the completed applications together with recommendations to our final selection committee at M. I. T.

Sixty-two students were finally selected and attended the fourteen-week semester—six from Finland, two from Sweden, five from Norway, four from Denmark, four from Belgium, five from The Netherlands, four from Great Britain, eight from France, one from Germany, one from Austria, nine from Italy, three from Czechoslovakia, six from Poland, and four from Greece.

In order to establish contact with the various governments concerned and to obtain governmental aid in matters of selection and publicity, two committee members visited Washington during the January holiday. Excellent cooperation was obtained by the committee from nearly all of the ambassadors and ministers and from the U. S. Department of State and the Civil Affairs Division of the Army.

While our selection procedure and our contact with the governments were going on, we were also busy on our fund raising. Our initial budget was set at $90,000. Tuition had been granted by the M. I. T. Corporation; we next approached the M. I. T fraternities to see if they would house the students. All of those fraternities remaining open during the summer agreed to do so, and another hurdle was successfully passed. Our actual cash outlay was first set at $25,000; later it was revised upwards to $35,000. This covered food, books, laundry, equipment, insurance, haircuts, dry-cleaning and incidentals, plus some of the transportation costs not already paid by the governments.

We first thought that the various educational foundations would be able to give us grants to aid in our Project. We found, however, that they allocated their funds during the summer and we were too late to obtain grants. A faculty and student drive gave us operating funds, but we had to rely on individual contacts to raise most of our money. It was a nearly impossible job. Committee members worked long and late for months, getting out over two thousand letters, checking lists and making personal visits; and, flunking quizzes.

We announced our Project to the press and radio on March 1, and we have since been very fortunate in having excellent coverage in papers throughout the country. The *Christian Science Monitor* has followed our program very closely, and other Boston papers, the *Herald*, the *Post*, and the *Traveler*, as well as the *New York Times* and the *New York Herald Tribune*, gave us fine articles. Radio station WRUL furnished time for us to broadcast short wave to Europe on March 21, inviting the students to participate. Other local stations gave us time to request financial support from the community, and planned other programs. The *New York Times* had a picture story of the Project during the summer, and the M. I. T. clipping service has sent us a total of 207 articles from newspapers in 28 states and in some foreign countries.

Time went on; applications poured into our office, final arrangements for transportation were completed,

(*Continued on page 24*)

that "wild blue yonder"

By Robert J. Vidal, '49

Safety, Comfort, and Reasonable Prices Found in New Private Planes

From December 7, 1941 until after August 1945, the American public was deluged with optimistic advertisements and magazine articles depicting John Q. Doe parking his own luxurious thousand dollar airplane or his twelve hundred dollar heliocopter in his backyard.

November 1948 finds the majority of John Q.'s nursing tired pre-war automobiles and looking to the air primarily for their daily supply of oxygen. The skies have not become black, or even a dull gray, with thousands of personal airplanes. To be sure, there is no shortage of pilots or of airplanes, but in its present package, the personal airplane does not appear to be too desirable. Private flying has been on the up-swing since pre-war days, but the American public still is not flying as it thought it would.

Before the last war it was generally agreed that there were basic faults retarding private flying. Many of these faults were chalked up against the airplanes, while some were inherent in the flying game. The outstanding faults were lack of safety, comfort, utility, and performance, along with high initial and maintenance costs. The inherent fault with flying was the inaccessibility of flying fields. Let us examine each of these faults and find what has been done, along with what remains to be done.

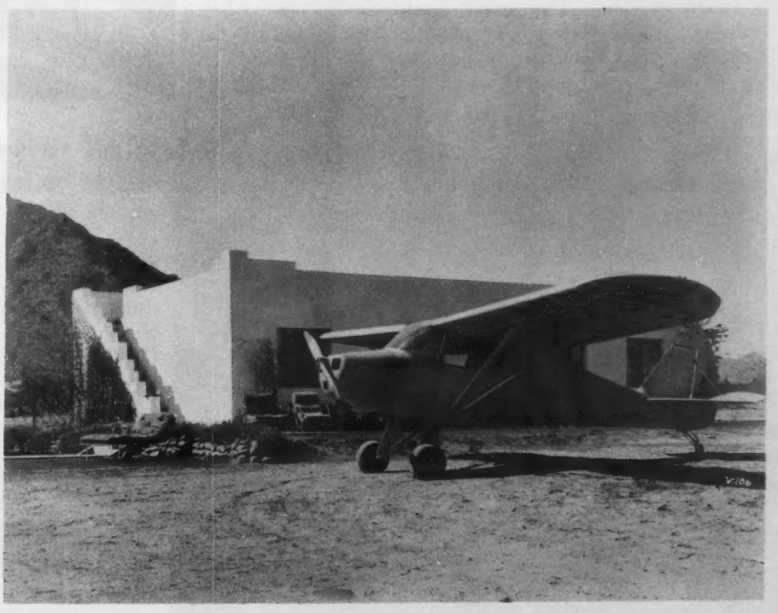
The one fault the public persists in dwelling on the most is an apparent lack of safety in airplanes. Airplanes are not the safest things in the world, but they are by no means the dangerous contrivances many people judge them to be. Most of the criticism against aircraft is offered by people who have never been closer than one hundred yards to an airplane.

True, airplanes can be dangerous. Manufacturers can make their airplanes stall-proof and spin-proof, but they cannot make them "fool-proof." A vehicle is only as safe as the person using it. As long as pilots foolishly continue to wave hello to the girl friend while buzzing at fifty feet, we will continue to have airplanes that are not "fool-proof." It is interesting and instructive to note that some 75 per cent of all private aircraft accidents are due to pilot error.

The Civil Aeronautics Authority regards the tail-spin and the stall as two of the most dangerous maneuvers. The aircraft manufacturers join in this belief and are continually attempting to design these maneuvers out of their products. Their attempts have been fruitful as is shown by results. The Ercoupe is recognized as being spin-proof, while most other airplanes are spin-resistant and stall-resistant. A pilot with some three thousand hours in the air attempted to stall and spin two resistant airplanes. After an hour of making all the known blunders, the pilot was able to make a Piper Vagabond do a half-hearted stall followed by a slow spiral. No spin was forthcoming. His similar efforts in a Stinson Voyager ended in getting the airplane to fly in a nose-high attitude with no tendency to stall or fall off in a spin. His opinion was that both these airplanes were very highly stall- and spin-resistant!

Those aircraft that are not termed stall- or spin-resistant are designed to give ample warning when approaching a stall or spin. No pilot could help but notice the warning signs and correct for his blunders.

Lack of comfort has been one of the biggest faults with airplanes for many years. The thought of climbing through wires and struts to gain entrance to a cockpit bulging with stray knobs and handles has squelched many flying enthusiasts. Today the price of an airplane is not determined by the cabin interior, but the reverse



The Piper PA-15 Vagabond, featuring safety and pleasurable flying

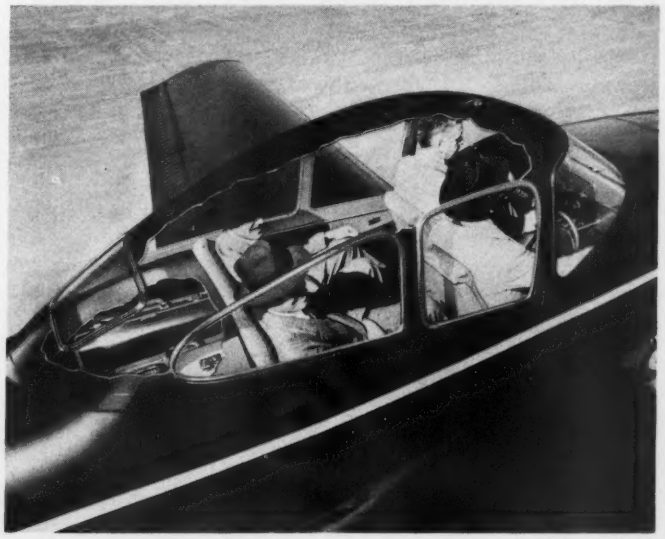
tends to be true. For $1,990 you may buy a Piper Vagabond with the interior finished in bright blue and yellow airplane fabric and with simulated leather seats. You still have to get past a wing strut to enter the cabin. For $11,000 you can buy a Beechcraft Model A35 Bonanza with interior appointments that would put a new automobile to shame. You would find that two steps, each ten inches high, were needed to enter the airplane. Inside you would find seats that are the ultimate in comfort. But before the reader drops airplanes with the mere mention of these two extremes in price range, let it be said that Swift, Piper, Aeronca, Cessna, Stinson, and others offer fine automobile interiors along with good performance and more moderate prices.

Airplane utility is now what the owner wants to make of it. The aircraft industry has finally come to the conclusion that the personal plane must be sold for more than a Sunday afternoon toy, and most manufacturers market their products with removable seats and with the accent on use as a high speed delivery truck. Seats removable in three to five minutes with allowance for some 600 pounds of cargo in 50 cubic feet of space are the keynote in such airplanes as the Stinson Flying Station Wagon, the Ryan Navion, and the Aeronca Sky Sedan. The public has caught on to this swing towards a useful personal plane, and manufacturers' files are filled with testimonials as to the usefulness of their individual products. An airplane useful for long trips and for carrying rush orders for products appeals not only to larger factories but also to farmers and small businessmen.

The initial cost of purchasing some airplanes is high, but it is not so high that flying is out of reach for John Q. Doe. A man with a $4,000 per year income can afford to fly. Though he may not be able to purchase a Ryan Navion or a Beech Bonanza, the lighter and cheaper planes are available. For example, a farmer with an annual income of $4,300 and with a family of six recently purchased a Piper Cub Special 65 for $2,495. He and his son learned to fly in their plane at a cost of two dollars per hour for instruction and one dollar per hour for gas and oil. They both soloed at a total cost of sixty dollars and now fly from an 800 foot strip on their own land. Their Cub is used primarily for pleasure flying but has on occasion been pressed into service as a cargo carrier. The total maintenance cost after sixty hours of flying was exactly two dollars. An isolated case? Perhaps, but a man who learned to fly at the same airport used a Stinson Voyager in commuting twenty-five miles to work. After 550 hours of operation (equivalent to two full years of service), this man's maintenance costs were five dollars for new brakes. This man flew daily, winter and summer, in one of the most mountainous regions in the East. During the two winters of use, the man was grounded because of weather for a grand total of ten days.

The prime fault with flying is the general inaccessibility of flying fields. Many people would like to fly, but being forced to travel to the city limits does not promote that flying urge. This fault is due of course to the fact that most modern planes require long stretches of land for takeoffs — land which is not available within the city. A recent Harvard report laid the blame for this fault on the first aircraft designers, who were content to sacrifice short landing space for high performance in the air. Today's airplanes land at speeds ranging from 50 to 90 m.p.h. Many experts believe that an airplane boasting a 30 m.p.h. landing speed along with a 100 m.p.h. cruising speed would be more acceptable to the public than are the present models. Some designers are calling for ornithopters capable of landing at a forty-five degree angle and capable of using a backyard as a landing strip. Futuristic? Yes, but many other men have been similarly categorized. No one can doubt that there is much room for improvement in this single field.

Performance in the air can best be judged by looking at the current line of popular airplanes. Starting with the lower price brackets, Piper, Aeronca, and

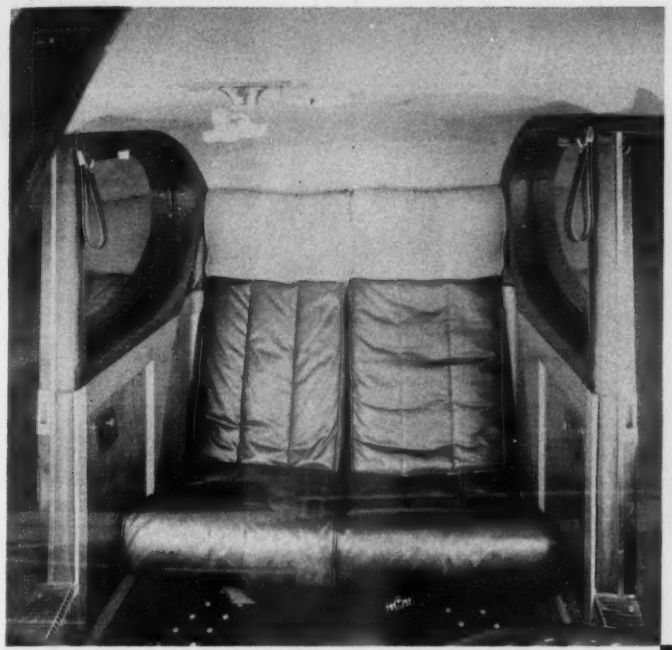


Beechcraft Photo

In this cutaway view, the Navion's limousine comfort for four passengers is shown.

Final production and assembly line at Beechcraft's Wichita plant, showing Model A35 Bonanza and Model 18 transport

The automobile-like interior of the Stinson Flying Station Wagon showing the removable rear seats. Note the ceiling loudspeaker for enjoyment by all passengers. *Stinson*



Taylorcraft lead the field. Piper's new PA-15 Vagabond priced at $1,990 offers side-by-side seating for two large people while cruising at ninety m.p.h. and landing at forty-five m.p.h. The Vagabond should prove to be a cheap and popular airplane. It was designed with low price and safety as prime factors. The airplane was not meant to compete with any airplane on the market. It was meant to create a new field.

The Piper Cub Special 65 and the Cub Special 90, priced at $2,495 and $2,572 respectively, seat two people in tandem and appear to be the old Piper J-3 with new paint and an engine cowling. Cruising at 87 m.p.h. and landing at a reported 38 m.p.h., the Cub Specials offer little in comfort but much in safety. The Cub has been affectionately labeled the airplane that will forgive any pilot.

Comparing with the Cub Specials in price, Aeronca offers a side-by-side Aeronca Chief boasting similar performance but with a little more eye-appeal. Aeronca designed a trim little Chief, and it is rapidly gaining favor among flying enthusiasts.

For $3,825 F.A.F. (Fly-Away-Factory) you can obtain a Piper PA-14 Family Cruiser, carrying four passengers at a cruising speed of 110 m.p.h. while landing at 50 m.p.h. The Cruiser leaves something to be desired in comfort, noise level, and beauty; but it remains one of the cheapest four-place airplanes on the market and should prove to be popular.

Selling for a little less than the Cruiser, the Aeronca Sedan has entered the four-place field. With an all metal wing and ample room inside, the Sedan should also prove to be a popular family airplane. The Sedan offers many of the features stressed in the higher priced four-place airplanes, including automobile-type interior, removable seats, short takeoff and landing requirements, and excellent visibility.

Cessna, Luscombe, and Swift are the major contenders in the middle-price bracket. The TEMCO Swift is a very trim all-metal, low wing monoplane with retractable landing gear. Priced at $3,995 for the standard model and $4,495 for the deluxe model, the Swift gives its owner a cruising speed of 140 m.p.h., a landing speed of 50 m.p.h., and generally good performance. The Swift had a poor start when first introduced on the market and was labeled a very "hot" airplane. The plane has since been re-designed with many improvements, but the label has clung in many instances. At present it is a safe light plane with fighter plane lines.

Cessna entered the post-war two-place market with its entirely new models 120 and 140. The 140 uses an 85 h.p. engine while the 120 comes with a 65 h.p. engine. A high wing monoplane with all-metal fuselage and tail surfaces, the 140 cruises at an honest 110–115 m.p.h. and lands at about 60 m.p.h. The one fault with the Cessna is that it takes more space for takeoff than do other comparable two-place airplanes.

The Observer 90 is the latest addition to the Luscombe line. It is a two-place tandem-seating airplane with unexcelled visibility. Apparently designed to meet Air Force specifications as a liaison airplane, the Observer is priced at $3,195. Unfortunately, it is quite noisy. Since visibility in all directions was necessary, little soundproofing could be used.

In the higher priced four-place market we have Stinson, Cessna, Beechcraft, and Ryan competing for

(*Continued on page 28*)

Photo Association, Dallas, Texas

The all-metal TEMCO Swift in a Texas setting. Note wide landing gear and wing slots for stability both on the ground and in the air.

NIGHT AND DAY

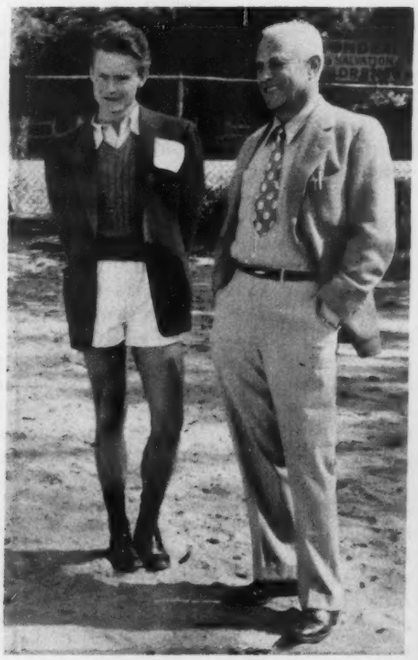
Frosh spend eventful week-end at the perennial Freshman Camp at Sharon—they soon ferret out and dunk the Soph president (see below). After Registration Day, though, the battle isn't quite so one-sided, either during Field Day competition, or during "study time" (see opposite page).

Sophomore class president takes an enforced dip — an old Frosh custom

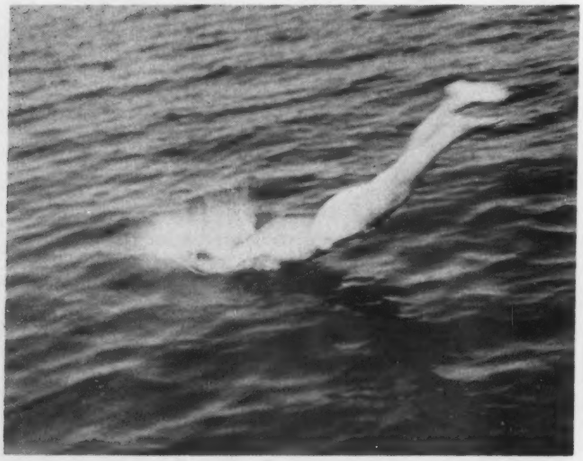
Dripping, but glad it's over with

FRESHMAN CAMP

"— by the way, are you Dean Baker?"



Lake Massapoag — cold water didn't scare everybody

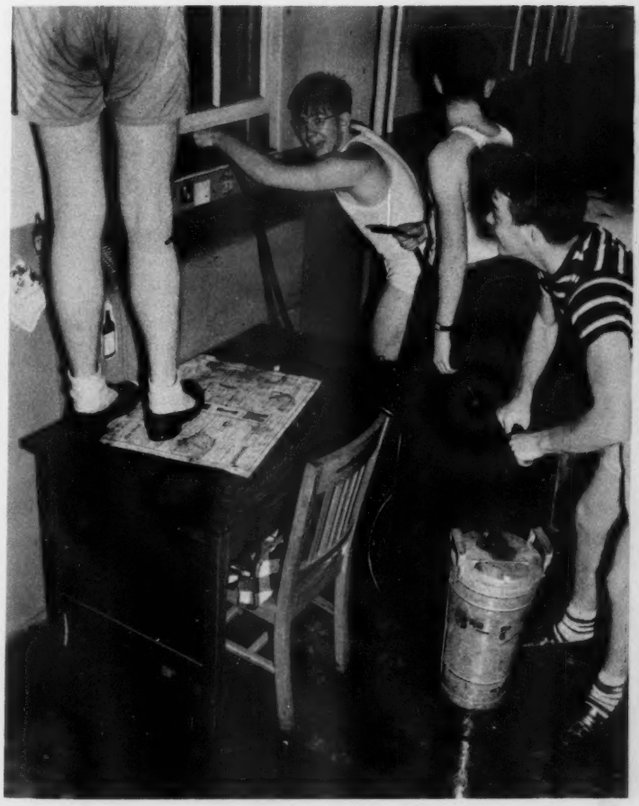


FROSH VS. SOPHS

uh . . .h!

Soph crew gets set for Field Day races

Old-fashioned victory in the "Barracks"



Must be slippery

middle east jigsaw puzzle

By Marc Alfandry, '50

A Reawakening

The Middle East is difficult to define as a geographical expression for it means many places to many people. For the purposes of this article it excludes Greece and Turkey, embraces above all the former British sphere of influence and lands predominantly Arab in character.

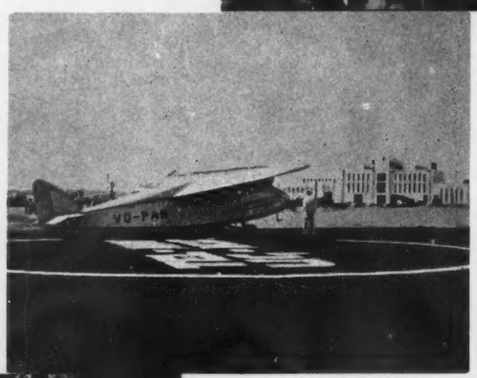
What is our interest in the Middle East? It should go somewhat beyond admiration for ancient Egyptian art or Sunday-school Bibleland recollections. One of the vantage points from which to look at the Middle East is that of world strategy. No all-weather, round-the-world air route can be developed without the use of the Middle East. American airplanes fly almost every route in the Middle East and millions of dollars have been spent in the building of costly air installations during the war. Moreover, to reach around the world, or to reach eastward to China and the Pacific by water, free access to the Mediterranean and the Red Sea is required. The security of such vital points as Suez, Aden, and the Persian Gulf must be assured against any aggressor, military or economic. Russia sees a route to India and the warm waters of the Indian Ocean lying across Iran. Baghdad stands as a gateway between Russia's millions of Moslems and those of the Middle East.

Centuries ago the Middle East wealth was fabulous. Even today the area is not without abundant resources and products. The Middle East offers hides and skins, wool and flax, superb coffee, long-staple cotton, citrus fruits, rugs, and a variety of other products. But outstanding is oil — oil in quantities that seem fantastic. Around the Persian Gulf lie proven reserves thought to contain twenty billion barrels. But this is only part of the story. Oil has been found in Eastern Egypt and is being drilled for in the Western Desert and in the hills around Mount Sinai. Nations go to the Levant these days not for faith and glory as in the days of the Crusaders but for oil. So we find the United States, with hundreds of millions of dollars invested in Arabian oil and her own stocks running low, is now as interested as anyone else in the Eastern Mediterranean.

It is no exaggeration to say that the area is starved for American goods. Its imports are kept at a minimum because of the shortage of dollars. The small industrial plant already existing is outworn and needs revamping. Its railroads need rehabilitation; buses and street railways are in poor shape. Everywhere costly transportation crawls on two cylinders and threadbare tires. There is almost no air-conditioning or refrigeration, few sewage and water-supply facilities. The few tractors and harvesters available have opened up new vistas in farming. And with industrialization — as the region learns to make cheap textiles, fertilizers, even steel from the rich and accessible ore veins of Upper Egypt, and to harness the vast waterpower of the Nile, the Euphrates, and even the Jordan, eventually — a vast new consuming public is bound to come into being without too much delay.

The Middle East's old sources of supply are almost all gone. Germany, Italy, and Japan furnished it with machinery, textiles, drugs, and building materials. The Iranian industrial plant is almost wholly German. Siemens did a thriving business in Egypt and Palestine. Now great opportunities exist for United States trade in the region. The population believes Americans believe in trade and not exploitation. They like United States

Transportation ranges from the most modern to the most primitive



One of the increasing number of airfields in the Middle East

Probably this camel needs his rest

goods, gadgets, even manners. There is no problem of salesmanship. The only great problem is the financing of export trade.

The lack of regular imports from abroad ever since the blocking of the Mediterranean sea lane at the beginning of World War II has had the effect of fostering industry in the Middle East to an appreciable extent. Such production as existed previously was carried on in small workshops by artisans and craftsmen whose working personnel consisted primarily of the members of their families. However, the nationalistic desire of the various countries to become economically self-sufficient served as incentives for various groups to initiate movements for industrialization, and the states contributed encouragement through an appropriate tariff policy. Among the new industrial fields developed during the war are dehydrated vegetables, glucose, lead refining, cast iron pipes, steel castings, lead tubes, copper sulfate and cigarette paper. The production of spare machine parts was also started as well as that of some simple electrical appliances such as batteries. Among the already established industries, the cotton piece goods production rose from 77 million square yards in 1937 to 370 million in 1942. Production of sugar rose from 160,000 tons in 1937 to 190,000 tons in 1943 and that of beer from 1½ to 9 million gallons. Production of paper, glassware, soap, glycerine, alcohol, paints, cement, jams, and some chemicals also increased.

The expansion was effected for the most part by the utilization of existing machinery, plants, and technical skill which had not been utilized to the highest capacity before the war. The success of wartime development depended on the availability of machinery, or the possibility of importing it, and the existence of technically trained personnel. Both were more available in Egypt and Palestine than Iraq or Syria. As a matter of interest, it may be pointed out here that productivity of labor in the Middle East reaches only one-third to one-half of American or British standards.

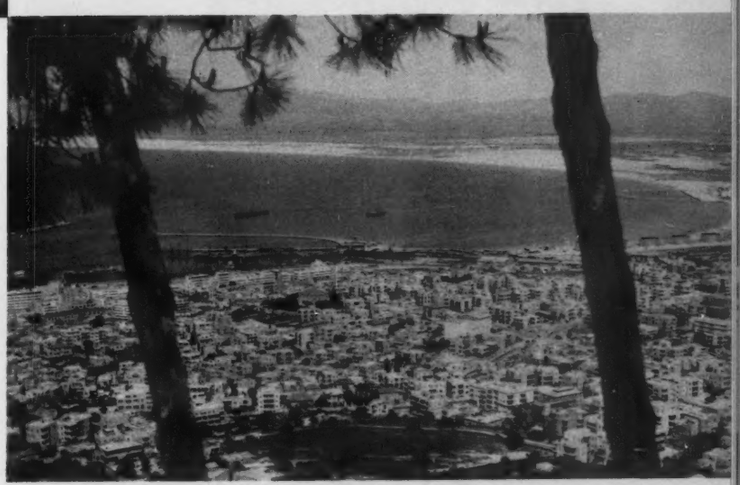
"Open Air" meat market

What has happened in the Middle East politically at the end of the war is known to us. Industrially, reconversion has been fairly successful and has not been accompanied by too much unemployment; this is because the area did not produce armaments and most of its production found ready buyers in the goods-starved civilian markets. It is difficult to foresee the future course of events in the Middle East. Too many economic, and particularly political, variables have to be accounted for. One thing seems to be clear, however: the war gave industrialization a great impetus. Furthermore, the Middle East has become a great center of oil production and refining and the availability of fuel will undoubtedly influence industrialization. These facts are of importance both for the future situation of the Middle East and the trade relations with that region.

Another vantage point from which to look at the Middle East is that of historical and social relations. A great change has come over the relations between East and West during the past fifty years — a change that is still in full tide and the real trend of which cannot well be determined. Self-confidence and the feeling of their own importance have been aroused among Oriental peoples by increased tension in international affairs and the enhanced interest of the Great Powers in the Middle East.

The most outstanding feature in Middle Eastern national states is that in all of them the relics of a common past are evident. The land included between the Black Sea and the Persian Gulf, the Red Sea and the Oxus, was once a single great unity. At one time this unity was subject to the Persians, then to the Greeks, at another time it was overrun by Islamic Arabs from western Arabia, and again by Mongols from the East. It fought and endured as a whole, even when divided between two major rivals — Turks and Iranians. Only the vastness of the area, the extent of its mountain ranges, the desolation of its deserts, the chaotic mixture of races, made possible a series of evolutions which would have disintegrated a more compact political entity like a national state. Many things that were essentially incompatible lived together under the common roof of Islam and through the ups and downs of Iranian dynasties. Kurds and Armenians were neighbors, loathing one another. Assyrians and Maronites continued to live as they had done in the first centuries after the birth of Christ. Tartar sections of the population were incited to revolt against their rulers by warlike invading Tartar tribes.

Nowadays, however, these groups are no longer a collection of fragments constituting two ill-organized empires, but are divided into nine or ten nationalistic states. As such their differences and desires have become a problem. To understand this problem, it is necessary to know the background of each tribe, in what manner they adapted themselves to local conditions, why they split and fought one another, and how they are reacting to the latest Western invasion — the invasion of applied science and technology.



A populous, modern Middle East city

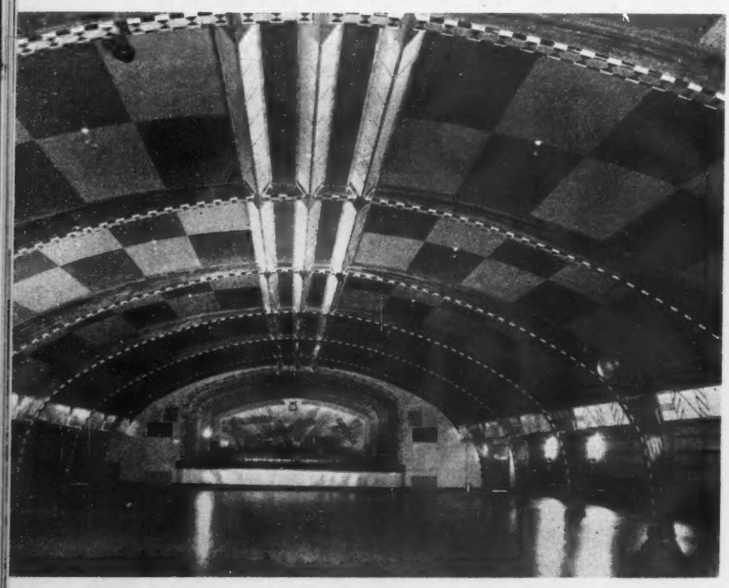
wood for thought

By Jerry B. Levine, '51

New Uses, Both Chemical and Structural, Will Alleviate Metal Shortage

Wood and wood materials have always been important structural and engineering materials, but increased interest has recently been directed towards them by predictions of metallurgists that the world's stock of metals may be exhausted in the foreseeable future. There have been new developments in the use of wood — increased utilization of its components and improvements in its treatment as a whole — which will increase its usefulness to man.

Essentially, wood is composed of multitudes of fibers joined together by a cement. The fibers consist principally of cellulose, while the cement is a substance known as lignin. The cellulose comprises about 60 per cent of the wood and the lignin about 28 per cent. The lignin can be separated from the cellulose fibers by a chemical process permitting each substance to then be utilized individually. The fibers are what is commonly known as pulp and, after further processing, can be made into paper products or converted to rayon or other cellulose derivatives. Their uses are many and diversified and need not be gone into here. The lignin, on the other hand, has long been a puzzle in that no function could be found for it. This was due mainly to the fact that it has no definite physical structure and has resisted chemical analysis. More than sixteen million tons have been thrown away as waste in a single year. It was recently noticed, however, that lignin is not completely saturated. In recent experiments, lignin and hydrogen were placed in a bomb and subjected to a pressure of four thousand pounds per square inch at a temperature of 480°F. for several hours. It was discovered that the brown, powdery cement had become a transparent liquid. Methanol and four other compounds new to the chemical world have been fractionated from this liquid; it appears that many new uses for the previously discarded lignin may be found in the near future.



U. S. Dept. of Int. Forest Prod. Lab.

Laminated wood arch construction provides attractive buildings with large floor areas.

There have also been many changes in the handling of wood as a whole. In the first place, there have been many improvements in mechanical technique. Joints and fastenings, long a weak point in wood construction, have been improved by modern connectors which, when used together with bolts, increased torsional stiffness by improving the shear resistance between adjoining beams.

The uses and efficiency of wood have also been extended through improved glues and gluing techniques. Synthetic resins have been developed which resist continuous exposure to moisture changes. Previous to the perfection of this type of glue, the ones most in use were starch, hide, fish, casein and blood glues. Of these the casein and blood glues were most useful. The casein glue is still used in airplane construction, while the blood albumins were used in woodworking because of their waterproof and durable nature. The most widely used of the new synthetic-resin glues are the urea-formaldehyde and phenol-formaldehyde types. These may be combined with each other, with other glues, or with other materials; consequently, there are many different synthetic-resin glues; but they may all be classified as either thermosetting or thermoplastic. The thermosetting class of glue maintains its rigidity after it has once set, even though it be subjected to higher temperatures than those at which it originally hardened. In this group are included the phenol, urea, and melamine resins. Each resin glue of the thermoplastic class, however, softens whenever the temperature is raised above its original softening range. In this group are included vinyl acetate and butyrate. All thermoplastic resin glues must be heated and then cooled under pressure when applied. Recent tests, based on a comparison of the physical and chemical properties of the glues, and on their performances under varying conditions, have shown that the synthetic-resin glues are superior to all others. One of these tests measures the durability of glue subjected to a wetting and drying cycle. It was found that animal and starch glues lose all their strength soon after soaking, that protein and casein glues are useless after two years, and that blood glue is greatly weakened after six years; on the other hand, the resin glues on which data are available show only moderate weakness after six years. These resin glues are further strengthened by electrostatic heating. They are now marketed in many forms including a dry powder one, suspension or a solution in water, and a non-aqueous solution.

There have also been recent developments in the forms of wood construction. First, there is a new type

of structure, called rigid frame, which is composed of a wooden frame covered with a sheet material such as plywood. Such a structure was successfully used at the Great Lakes Exposition in Cleveland not long ago. Its strength and rigidity have not yet been conclusively demonstrated, but it is gaining favor.

Another new construction form is the barrel roof, in which a sharply arched roof is made of a thin membrane. This type of roof has been previously constructed of concrete but may be made of wood in the future, although details for this have not yet been worked out.

Progress has also been made in the chemical treatment of wood. New chemical drying methods quicken drying and eliminate many drying defects. Wood preservation has also been advanced, thus prolonging life and increasing serviceability. Another advance has been the recently perfected processes of wood impregnation and compression. In the first of these processes, known as "impreg," wood is impregnated with the newly-developed phenol-formaldehyde resins, the resin forming materials entering the cell wall and combining chemically with it. In the compression process, wood is submitted to very high pressures. There is also a combination of these two processes which is known as "compreg." A fourth process is known as "staypak" and is a result of great compression at high temperatures without resin impregnation. Extensive tests of these products have been carried out at the Forest Products Laboratory of the United States. The results are fairly encouraging.

It was found that certain properties of "impreg," "compreg" and "staypak" were improvements, though only at the expense of other features. The moisture resistance of the wood was increased by resin" impreg," and the wood also became more resistant to swelling and shrinking. The only substantial increase in strength was in compression, in which instance the flexural strength and rigidity were lessened.

In laminated "impreg" wood, the tensile, toughness, and impact strengths were decreased; however, the shear in the plane of the plies was improved.

"Compreg" was found to increase all properties except impact strength and toughness. It made the wood more brittle but increased its tensile and flexural properties.

"Staypak" has about the same characteristics as "impreg" and "compreg" except that it is less moisture resistant, is tougher, and has twice the impact strength. The change in its properties was found to be proportional to its change in density. In general, the wood was not greatly improved by resin treatment; and such treatment is of value only where the absolute strength of the wood is of importance and the weight does not matter.

Wood construction has been advanced by the improvement of laminating techniques. (A laminated board is one in which two or more layers of wood are glued together with their grains parallel.) The advantage of such construction is that it provides for more uniform distribution of strength and lessens change in shape due to moisture. A recent application of lamination is the construction of wood arches which are stronger and more efficient than any which were previously known to be possible. The laminated members can be made either straight or curved by bonding with a water resistant glue.

Another fairly new type of construction which has proven quite useful is the all-familiar plywood. Plywood is very similar to lamination, differing only in that the adjacent sheets have their grains at an angle

Footbridge over the Yahara River, Madison, Wisconsin, employing laminated wood arch construction *U. S. Dept. of Int. Forest Prod. Lab.*

to each other rather than parallel. Plywood can be constructed of any thickness and with any number of plies and is therefore readily adapted to a number of uses.

In addition to the uses of wood and fiber products individually, there are possible a tremendous number of combinations of these materials in various forms of "sandwich" construction wherein each material can be used to the best advantage. This technique is now being extensively used. A few examples will serve to point out its potentialities.

In the first place, plywood faces have been glued to low-density balsa wood cores to give a thick, stiff, strong, and lightweight construction for bombers during the war. This airplane construction proved quite useful.

Another application of the sandwich construction is to be found in housing. These sandwich panels represent perhaps the most important postwar advance in the use of wood. Basically, such a panel consists of a light, thick core, to both sides of which a thin, strong, dense sheet material is glued. The result is surprisingly stiff and strong for its weight, and the inner core also has excellent thermal insulating qualities. A sample building has been constructed on this principle by the Forest Products Laboratory at Madison, Wisconsin. The material there used for the core was a corrugated brown paper which was treated with a water soluble phenolic resin to strengthen fungi resistance and provide protection against moisture. The thin covers are of metal, plywood, or other sheet materials. The sandwich panels can be mass produced in factories with machinery which is available at the present time, and the panels can then be joined together in essentially frameless houses, thus saving time and labor. They have been thoroughly tested by the Department of the Interior and the results are favorable. However, full approval has not yet been given and depends to a large extent on how well the experimental house continues to hold up under severe weather conditions.

It can thus be seen that some notable advances have been made in the field of wood utilization, mainly in glues, chemical treatment, and sandwich construction. Nevertheless, there have been no startling revelations in this field. Wood, though more and more useful, cannot be reliably depended upon to substitute for metal to any vital extent in the near future.

rival for the vacuum tube

By Fred I. Diamond, '50

New Theory of Conduction Required to Explain the Transistor

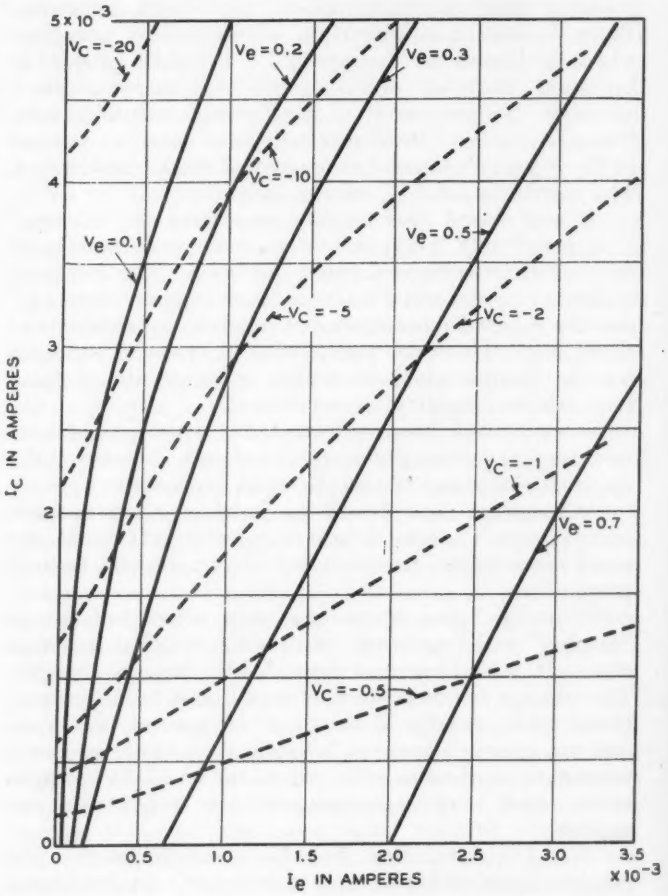
Physicists of the Bell Telephone Laboratories have developed an amazing, simple device, known as the Transistor, which may have a far-reaching significance in the fields of electronics and electrical communications. Capable of performing efficiently nearly all the functions of the vacuum tube, the Transistor, developed as a result of research conducted by Dr. John Bardeen and Dr. Walter H. Brattain and directed by Dr. William Shockley, works on a new physical principle discovered by the Bell scientists.

The device, which will serve as an amplifier or an oscillator, bears no resemblance to the vacuum tube which performs these functions, for there is no vacuum, glass envelope, grid, plate, or cathode. Less than an inch long, the Transistor merely consists of three electrodes connected to a block of germanium, a semi-conductor, about the size of a pinhead. Two of the electrodes, called the emitter and the collector, are hair-thin wires mounted perpendicular to the upper surface of the block at a separation of from .005 to .025 centimeters. The third electrode, a large area, low-resistance contact, is soldered to the base. The entire apparatus is enclosed in a metal cylinder slightly larger than a shoe-lace tip.

When the Transistor is used as an amplifier, a small positive bias is applied to the emitter, and a comparatively larger negative bias is applied to the collector by D. C. voltage sources such as batteries. When A. C. signals vary the emitter current, corresponding variations occur in the current passing through the collector, which may be connected to a load of impedance as high as 10^5 ohms. The result is a large ratio of output to input voltage and a corresponding amplification of the input signals which may be as high as one hundred-fold. The Transistor has been operated successfully at frequencies up to ten megacycles, and the power consumed in this unit is less than a tenth of that used by an ordinary flashlight bulb.

Amplification in the Transistor depends upon a small "area of interaction" on the surface of the germanium block. There the electronic structure of the semi-conductor is varied by the input current. If a terminal for the output current is placed in this area, the output current can be controlled by the input current, for the variation of the electronic structure modifies the flow of current in the semi-conductor.

Ordinarily, current is carried by the movement of electrons, and the conductivity of a substance is dependent upon current-carrying electrons. In good conductors such as metals, there is approximately one current-carrying electron per atom. The conductivity of insulators is very low, for there are few current-carrying electrons. Semi-conductors such as silicon, germanium, and some metallic oxides, have approximately one



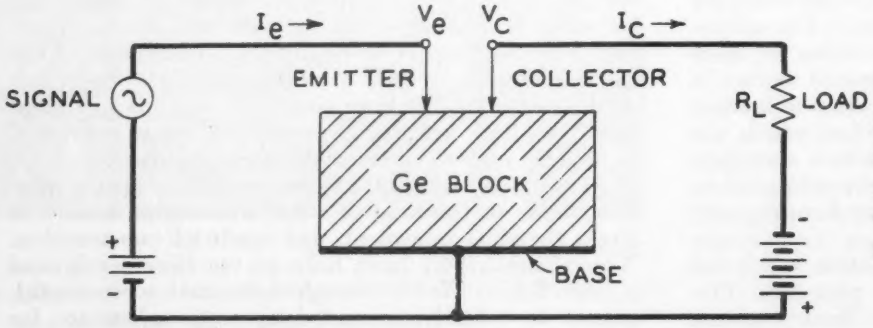
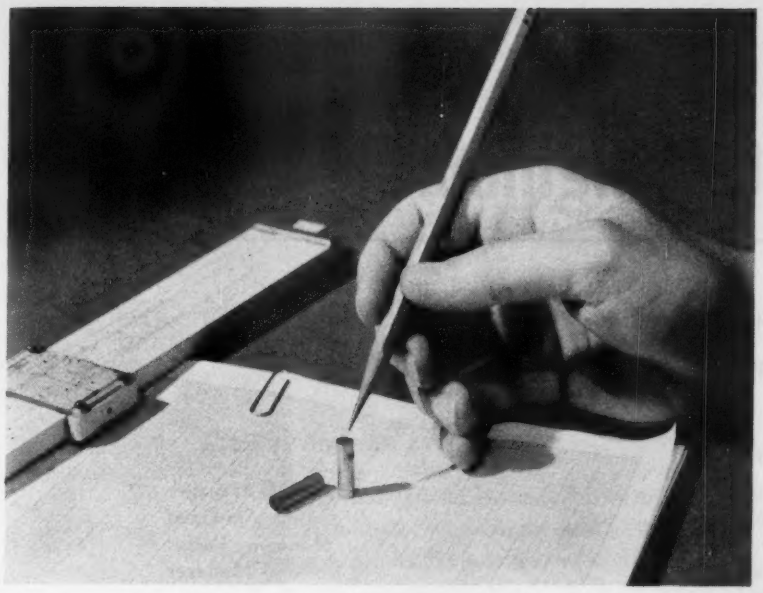


Fig. 1, at left, is a schematic diagram of the Transistor. Fig. 2, above, graphs the direct current characteristics of a typical experimental unit using the Transistor as an amplifier.



Here, in close proximity to familiar objects, the tiny size of the Transistor becomes startlingly evident. *Nick Zazarnick, New York, N. Y.*

A greatly enlarged cutaway view of the Transistor with a paperclip for comparison

current-carrying electron for every million atoms. The conductivity of semi-conductors, however, can be varied one thousand-fold or more by changes in electronic structure, apparently by varying the number of current carriers.

In the course of their research, the Bell scientists developed another theory of the conduction of current in semi-conductors. In these materials, most of the electrons do not contribute to the flow of current but are held in fixed positions. According to the Bell physicists, if one of these electrons is removed, the "hole" left behind can move like a bubble in a liquid, and, because of its electron deficiency, has a positive charge, thus carrying current.

In the Transistor, electron-carrying current flows easily into the input point and out of the output point on the surface of the germanium block, but the substance itself offers a large impedance to the flow of electrons. When a small current of a few milliamperes flows into the emitter, however, it produces "holes," forming the "area of interaction." These "holes" flow readily, for there is little impedance to their movement in the semi-conductor. These positive "holes" are attracted to the collector, which has a negative bias, and thus current flows. A signal voltage varies the emitter current, and a corresponding variation of the collector current occurs. The Bell Laboratory physicists found that the flow of "holes" alters the normal flow of current from the base electrode to the collector in such a manner that the change in the collector current is greater than the change in the emitter current.

The D. C. characteristics of a typical experimental unit are shown in Fig. 2. The emitter current, I_e, is related to the emitter voltage, V_e, and the collector current, I_c, by the close approximation:

$$I_e = \mathrm{f}\,(V_e + R_f I_c)$$

where R_f is a constant independent of the bias. The Bell scientists have interpreted this relationship as follows: the collector current lowers the potential of the surface in the vicinity of the emitter by $R_f I_c$, thereby increasing the effective bias voltage on the emitter by an equivalent amount, producing amplification.

Although the Transistor can carry out vacuum tube functions such as amplification, it is not adaptable — because of its own special characteristics — as a replacement for vacuum tubes in present electronic circuits but requires circuits specifically designed for this unit. Bell scientists have already constructed radio receivers operating with Transistors instead of vacuum tubes. The Transistor is also adaptable for use in telephone communication and has already been used for amplification of electrical speech waves traveling between two telephones.

The new device is still in the experimental stage; but great optimism on cost, life, and stability is felt, because of its simplicity and ruggedness and the moderate cost of basic materials. The Bell Telephone Laboratories is now setting up a small laboratory pilot plant, and Transistors for experimental purposes may soon be available in small quantities through the Radio Division of the Western Electric Company.

the tech engineering news

Professional Journal of the Undergraduates of the
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the dragon's den

The Lip and the Leg

Polish, French, Italian, Finnish, German, Norwegian, Danish, Belgian, Dutch, Greek, Austrian, Swedish, Czech, and — but for the United States immigration laws — Yugoslav young men, to the number of sixty-three, spent a puzzling summer here. They were trying to get to understand the U. S. A. in what time they had left over from intensive study of the engineering and technical advances made here during the War.

A difficult problem, certainly, and one doubts that they solved it "rigorously"; but, still, these students, most of whose educations were delayed by the War, had the maturity and openmindedness to absorb a balanced impression of this continent. Balanced in the sense of being part bitter, part sweet, part saccharine — realistic, to state it plainly. As they spread back throughout Europe, they will form a pattern of specks of knowledge that will slowly diffuse into the population. Since these young men — average age twenty-six — are highly trained scientists and engineers, their opinions will carry ever-increasing importance on a continent being rebuilt according to their plans.

These plans, for that matter, will be more useful and better thought-out because these students were here. No longer will the Polish physicist have to admit he has never seen a cyclotron or touched a Van de Graaf machine; the French radar engineer can now claim to have done more than see a magnetron tube — the heart of all modern radar. Not so often now will these men use scarce, outdated equipment in experimentation the results of which are already published in U. S. technical journals, unavailable in Europe except for precious dollars. Invaluable contacts with leading scientists in the U. S. have been formed.

Nor has the benefit been one-sided. We American students who were here this summer have now a saner perspective on European affairs. Direct knowledge of these Europeans dissipates the effect of propagandists of one side or another who try to present a stereotyped Europe. We now realize that in spite of apparently fundamental differences in education, and experiences, the individual characteristics were essentially the same. More surprising to us, no doubt, in our somewhat bloated conception of our scientific prowess, is the fact that many of these young Europeans were in the short period of their stay not only able to adjust extremely rapidly to the setup at M. I. T. but also to make very interesting contributions while working in our labs.

This Project is slated to be rerun next year by our National Student Association Committee in the name of M. I. T. students. If we really think as much of this Project as our words would indicate, we can demonstrate our support by joining or helping in the work of this short-handed committee, or at least by supporting any fund drive it may initiate at M. I. T. If we merely relax and let others do all the work, we have little excuse for complaining about the profusion of red tape and scarcity of concrete proposals in the field of inter-nation cooperation.

It is our individual responsibility to render less service of the lip and more service of the leg to such ideas and enterprises as the Foreign Student Summer Project.

H. C. W.

foreign student summer project—m. i. t.

(*Continued from page 10*)

and the date of arrival of the students grew closer. Since first impressions are always important, great pains were taken to organize and coordinate the students' activities upon their arrival. Members of the Committee met the students and had living quarters arranged for them in New York, usually with the help of the consuls or other diplomatic officials. Organized group activities were planned — tours of New York, trips to United Nations Headquarters, etc. — and the students, most of whom arrived between June 8 and June 14, all remained in New York until the reception at the Waldorf-Astoria on June 16. This reception was the high point of the week. Many ambassadors and ministers were present, and a world-wide broadcast was made from the gathering. Dr. Compton gave the official welcome, Mr. George V. Allen, Assistant Secretary of State for Public Affairs, greeted the students on behalf of the government, and Hendrik Kaufman, ambassador of Denmark, on behalf of the other governments.

Immediately after the reception, the students left for Cambridge to begin their academic work. Since most of them were advanced students, they were most interested in doing graduate work at M. I. T. Mr. Severance arranged for a simplified registration procedure and each student had an interview with a registration officer who aided him in his choice of courses. Some of the students (F. S. S. P.'s as they came to call themselves) took no courses at all but worked full time on research and investigations of their own. A British student finished his crystallography research paper here with equipment not available at his home university; an Italian student spent his time learning as much as possible about the electronic computor so that he could return to his country and construct a similar device. A Polish student worked with several M. I. T. professors on the designing and construction of a Van de Graaff generator — and thus became the authority in Poland on this topic.

Other students did some work in labs and also took advanced technical courses. Several of them were interested in taking a humanity (something not offered in most technical schools in Europe) and many of them, interested in our production and business methods, enrolled in some Course XV subjects. The students spent their time wisely and well in the libraries, laboratories, and lecture halls at M. I. T.

In addition to providing an opportunity for technical work and advanced study, we planned other important aspects of the Project. We felt that students would derive much benefit from first-hand knowledge of American industry, American people and institutions. Consequently, two plant visits were planned each week for about twenty students, while seminars and discussions were held at least once a week. An information program was organized to give the students an opportunity to ask their most embarrassing questions to a board of experts composed of prominent professors, scientists, newsmen, and artists. The students visited the United Nations, where they were greeted by Mrs. Eleanor Roosevelt. The Institute of the United Nations invited the students to spend a week-end at Mount Holyoke College to participate in panel discussions and recreational activities. WRUL offered radio time for each student to give a short-wave broadcast to his home country.

Since the students were to be here for only four months, we felt we should make every effort to have them meet as many people as possible. Help on home hospitality and week-end activities was given us by the United Nations Association of New England. Through the excellent work of Mrs. Thomas Synnot of Concord, each student received a week-end invitation to visit a home in the surrounding area which helped perhaps more than anything else to give our guests a real view of American life.

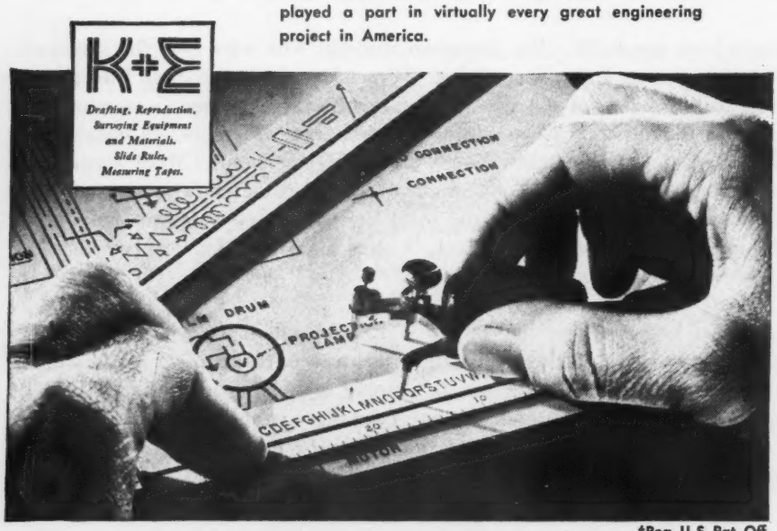
It seems clear to us that the Foreign Student Summer Project is one answer — and, we feel, a very good one — to the problem of increasing student exchange in the face of such overwhelming odds as the dollar shortage and the high cost of ocean transportation. It is an answer that can be given by students — one concrete way that students may aid in reconstruction and rehabilitation, and one direct method of building understanding between peoples.

It is a project that has not only made it possible for European students to study in the United States and learn to understand better our attitudes and our people; it has

(*Continued on page 38*)

partners in creating

For 81 years, leaders of the engineering profession have made K & E products their partners in creating the technical achievements of our age. K & E instruments, drafting equipment and materials—such as the LEROY† Lettering equipment in the picture—have thus played a part in virtually every great engineering project in America.



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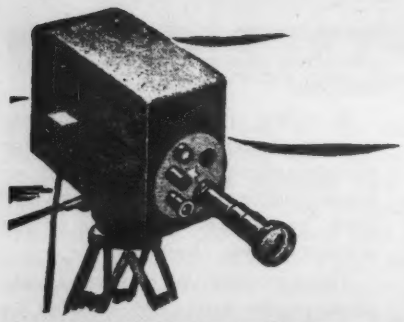

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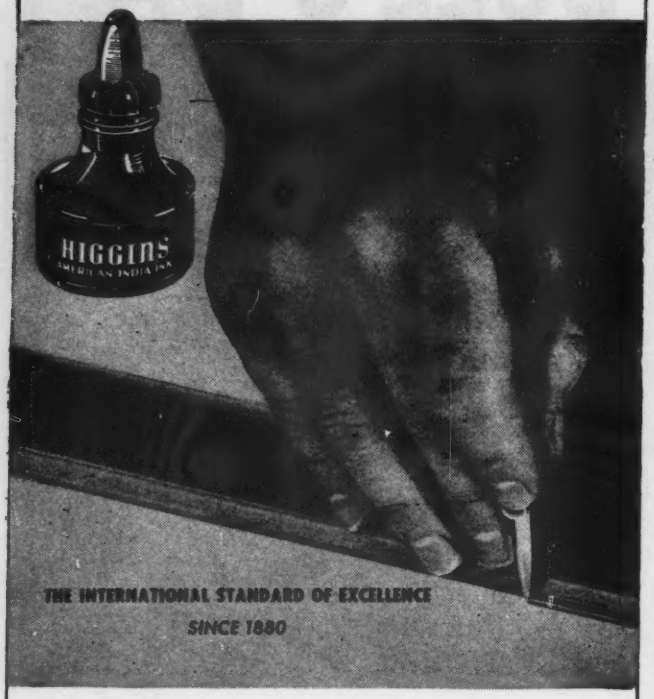

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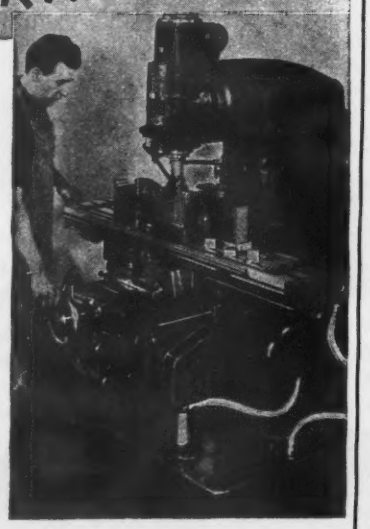

On the job shown above the work is quickly positioned for cutting several adjacent surfaces.

BROWN & SHARPE B·S

that "wild blue yonder"

(*Continued from page 13*)

honors. Up until the present, Stinson has led in sales; but the next year may very likely find Stinson losing its lead.

The Stinson Voyager and Flying Station Wagon are the same airplanes with different interiors. The Station Wagon features removable seats leaving a plywood Station Wagon interior that can be utilized in carrying 640 pounds of cargo. Both models are fabric-covered with an all-metal frame. The airplane continually startles people with its rapid takeoff and unusually steep climbing angle. Engineered primarily for safety and secondarily for beauty and utility, the Stinson has proven its ability to take punishment and to forgive blundering pilots. There is something to be desired in the Stinson as far as soundproofing and seating comfort are concerned; but, priced at $6,995, the two models offer high dependability coupled with a 130 m.p.h. cruising speed.

Cessna's contribution is the four-place model 170. Offering all-metal construction with good visibility, luxurious and roomy cabin, and good performance, the 170 can be expected to draw a good share of the four-place market. Priced at $5,475 F.A.F., the 170 boasts a 125 m.p.h. cruising speed with a 500 mile range. One of the best engineering features of the 170 is the fact that it is 50 per cent interchangeable with current Cessna models. Another of its outstanding features is the simple spring-steel landing gear found on all Cessnas.

(*Continued on page 32*)

ENGINEERS, like Ralph Hovey, R. P. I. '37 and William Godfrey, Rutgers '44, use supersonic device to test a metal's thickness.

LABORATORY EXPERTS, like Gloria Higgins, make many scientific tests to assure *quality* petroleum products for your use.

CAT CRACKER TESTERS, like A. J. Ely, Lehigh '47 and K. O. Johnson, Minnesota '42, run one of many checking tests at a giant catalytic cracking plant.

THEY'RE what count most with us!

PERHAPS THE MOST important thing behind the Esso Sign is not just the great laboratories and refineries of Esso Standard Oil Company...

No...it's probably just *the people and the kind of jobs they have!*

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Copies of our booklet, "Your Technical Career," are available at the Mechanical Engineering Placement Office, Student Placement Bureau, Department of Chemical Engineering, and Department of Chemistry.

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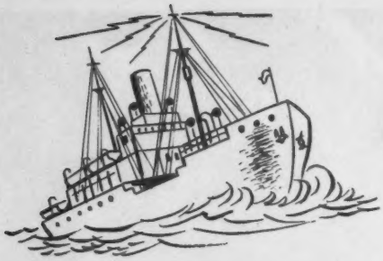
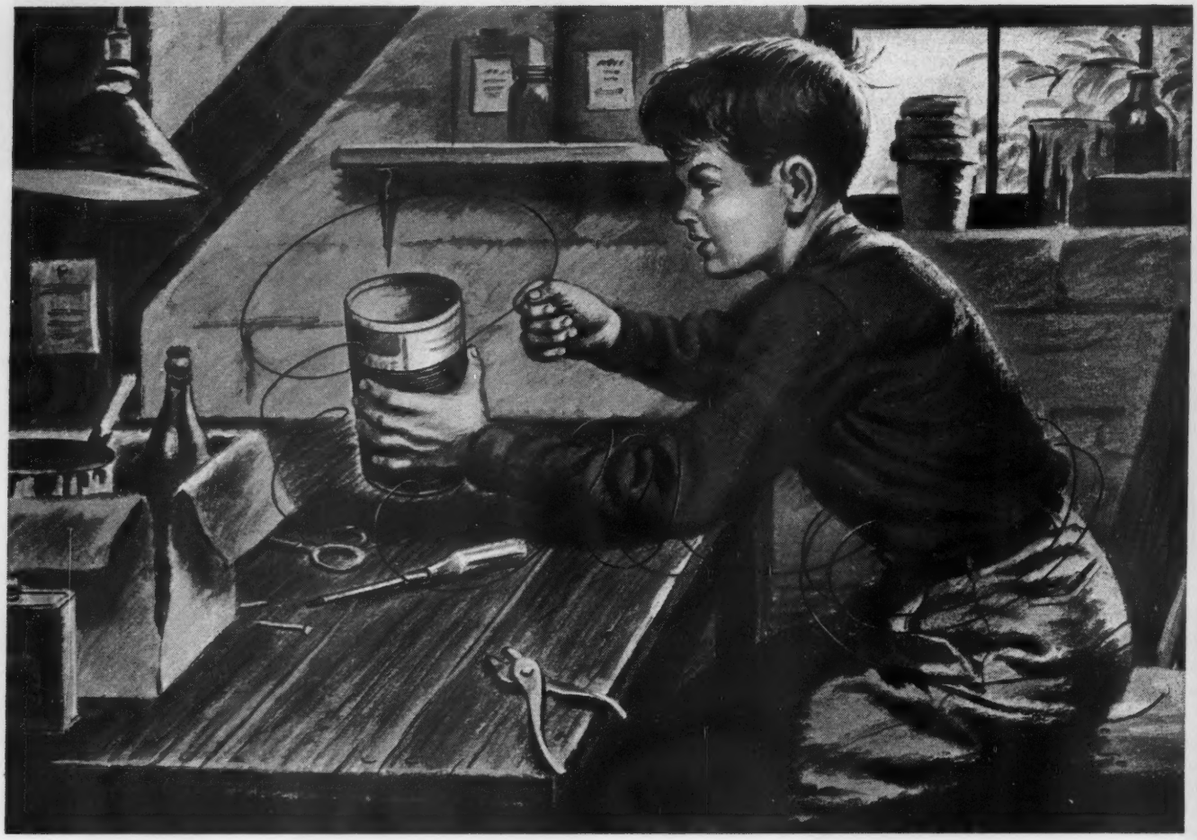
REFINERY WORKERS, like Bill Kohl, help make "Happy Motoring" come true at the famous Esso Sign.



Who named it wireless?



The ether which brings mysterious electrical impulses across the miles to your radio, has always enveloped the earth. It was there when Noah launched his Ark. So were all the elements that combine to make this modern miracle. But Noah's only contact with the outside world was a Dove.

Today any teen-aged youngster knows more about the subject than did Noah, yet, relatively speaking, we know as little about electricity as he did. We haven't scratched the surface.

Roebling saw the future of electricity and recognized the important part it would play in American industry, sixty-eight years ago. Roebling undertook the manufacture of electrical wires and cables in 1880 because it had confidence in America's future, and because it knew that individual enterprise and free competition speedily would create a steadily growing demand for its product. Roebling has consistently led the way in the design and manufacture of electrical conductors.

Roebling electrical wire and cable enjoys the well-earned confidence of electrical men—not only in this country—but throughout the world.

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DU PONT *Digest*

For Students of Science and Engineering

They said, "You can't do it!"

But Du Pont scientists developed a synthetic rubber with superior properties

"Synthetic rubber is an impossibility at any price!" declared a noted European scientist a number of years ago. And most people were inclined to agree because for more than a century chemists had been unable to duplicate natural rubber.

Du Pont scientists knew that all rubber had bad qualities as well as good. "Why struggle to duplicate its faults?" they asked. "Why not find a new chemical compound with all the good qualities of rubber, but none of the bad?"

They took as their starting point a discovery by Dr. J. A. Nieuwland of Notre Dame in connection with the polymerization of acetylene. By modifying this process, they made monovinyl acetylene. Adding hydrogen chloride, they made a new chemical compound called chloroprene—a thin, clear liquid at low temperatures. Like isoprene, it polymerized to form a rubber-like substance. But the new material, now known as *neoprene*, required no sulfur for vulcanization and was superior to rubber under many service conditions.

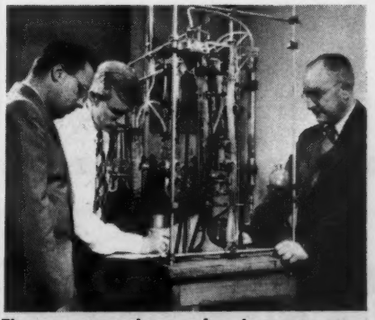
Today neoprene production is measured in millions of pounds a year, even though it is priced higher than natural rubber. Hardly an industry is not now using it, for such good reasons as these: neoprene products resist deterioration by oils and greases. They stand up under exposure to direct sunlight. Their aging and flame-retarding properties also are superior to those of rubber.

Three types of Du Pont research

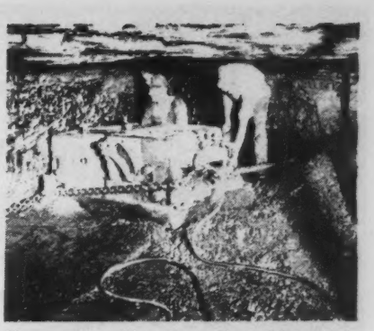
Modern research involves time, money, manpower. To develop neoprene, for example, took six years of laboratory study, a research and development expenditure of millions of dollars, plus the work of skilled research chemists, physicists, engineers, and other scientists.

At Du Pont, research is continuous. Some of it is designed to develop new products or processes; some to improve existing products or processes; and the balance is fundamental research to uncover basic facts without regard to immediate commercial use. Each of ten manufacturing departments has its own research staff and is operated much like a separate company. In addition, the Chemical and Engineering Departments, which are not engaged in manufacturing operations, conduct research in the interests of the Company as a whole.

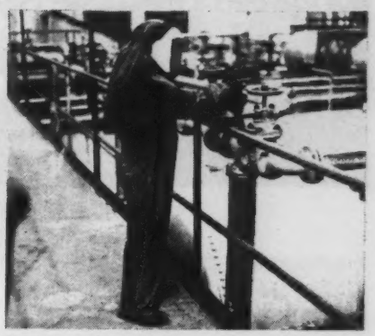
A typical Du Pont research team may include physicists, chemists, chemical and mechanical engineers, each of whom brings specialized training to bear on a specific phase of the subject. The man who joins one of these teams finds himself associated with some of the ablest minds in the profession and receives the opportunity and friendly support needed to make fullest use of his capabilities.



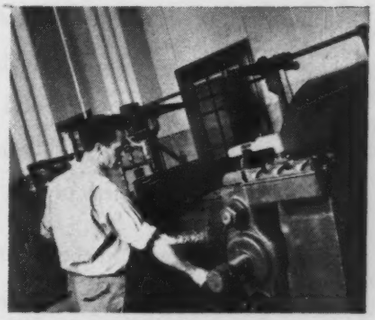
The new research man *has frequent contact with experienced supervisors. Here M. Hayek, Ph. D., Indiana '47, discusses data obtained in an experiment with F. B. Downing, left, a member of research supervision, and M. B. Sturgis, a research group head.*



Neoprene, *used in wire, cable and hose jackets, resists abrasion, oil, heat, and sunlight.*



Neoprene gloves *and protective clothing resist deterioration by chemicals, greases and oils.*



Milling and compounding *neoprene in the rubber experimental laboratory.*

What you want to know about Du Pont and the College Graduate

"The Du Pont Company and the College Graduate"—newly revised, fully illustrated—describes opportunities for men and women in research, production, sales and many other fields. Explains how individual ability is recognized and rewarded under the group system of operation. For your free copy, address: 2521 Nemours Building, Wilmington 98, Del.

DU PONT

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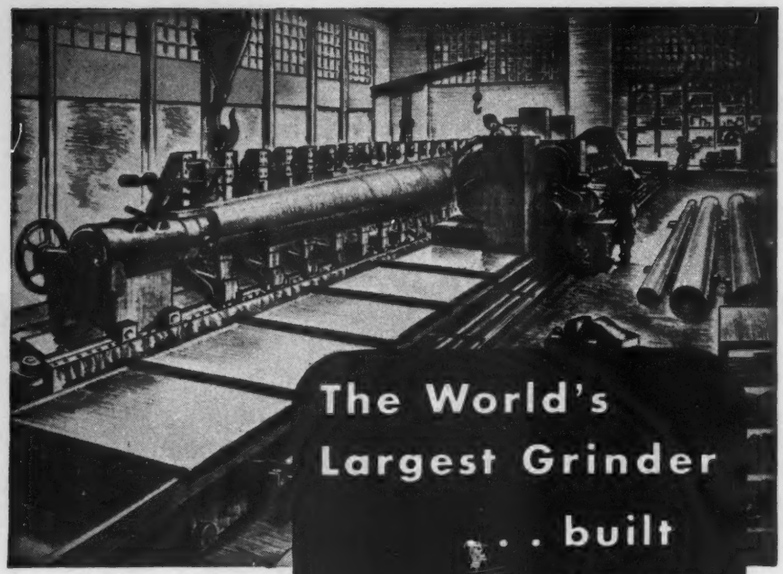

HERE YOU SEE the world's largest grinder receiving its final runoff test on one of the assembly floors of the Norton Machine Division. It handles huge cylindrical work as long as 68 feet and up to 36" diameter—and grinds such work to tolerances measured in fractions of a thousandth of an inch—approximately a tenth the thickness of this page.

The other extreme in the Norton line of cylindrical grinders is the tiny 4" Type C. There are also Norton machines for surface grinding, toolroom grinding, and such special work as automotive crankshafts and camshafts. And for producing still greater dimensional accuracy and higher surface finish, there's a line of Norton Lapping Machines—for both flat and cylindrical work.

Every Norton machine is expertly designed, expertly built and is expertly serviced by a highly trained field organization.

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(Behr-Manning, Troy, N. Y. is a Norton Division)

NORTON

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that "wild blue yonder"

(Continued from page 28)

This single feature does away with landing gear maintenance headaches so often encountered in other airplanes.

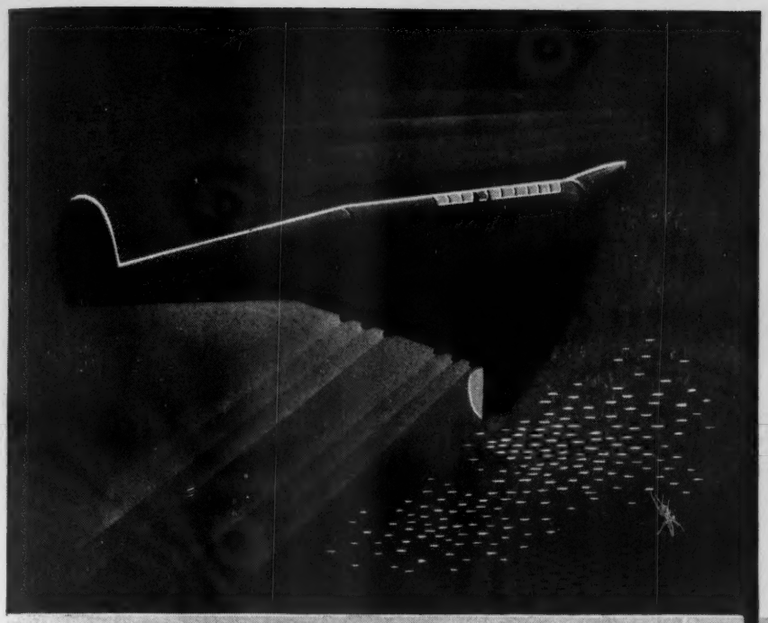
In the higher priced personal and executive type airplanes, the Beechcraft Bonanza and Ryan Navion occupy the spotlight.

Originally designed by the North American Company, the Navion was sold to Ryan and has been improved and marketed by Ryan. Resembling the famous P-51 Mustang in outer configuration, the Navion offers a choice of two-control or three-control operation. Through an ingenious arrangement of springs, the rudder pedals may be disregarded, allowing the pilot to rely on the wheel for normal flying. Cruising at 150 m.p.h. and landing at 55 m.p.h., the Navion is popular with charter service companies and with small establishments needing fast executive transportation or high-speed delivery service. The tricycle landing gear enables the Navion to operate from rough emergency fields. Its rugged construction, coupled with high speed and a price of $9,985, makes this airplane appealing to men who must travel over large territories at frequent intervals.

Selling for some $1,000 more than the Navion, Beechcraft has succeeded in producing a thing of beauty and comfort in the Model A35 Bonanza. Making no attempt to appeal to lower income groups, the Bonanza is made for those interested in luxurious and rapid air travel. Produced only on order, the Bonanza comes complete with all equipment, including a full instrument group, two-way radio, and an unexcelled cabin interior. The Bonanza cruises at 170 m.p.h. at 8,000 feet. It is unofficially reported that the Bonanza originally landed at 38 m.p.h., but since pilots could not get used to such a low landing speed, spoilers were incorporated thereby boosting the landing speed to 56 m.p.h. The Bonanza is used mostly for charter flying, for executive transport, for ambulance service, and by those people who can afford $11,000 airplanes.

The reader is now undoubtedly wondering why high landing speed was listed as a fault with current airplanes after finding that the present models have touchdown speeds as low as 40 m.p.h. An airplane may touchdown at a comfortable 55

(Continued on page 36)



Moving faster!

Efficiency in many mechanical devices is often a matter of high speeds and low weight. The resultant stresses make heavy demands on parts, whether they be in aircraft or automotive engines, machine tools or locomotives.

Molybdenum is the only alloying element that gives steel the two vital necessities for meeting such requirements—good hardenability and freedom from temper brittleness. Molybdenum steels will also meet the requirements of production economy.

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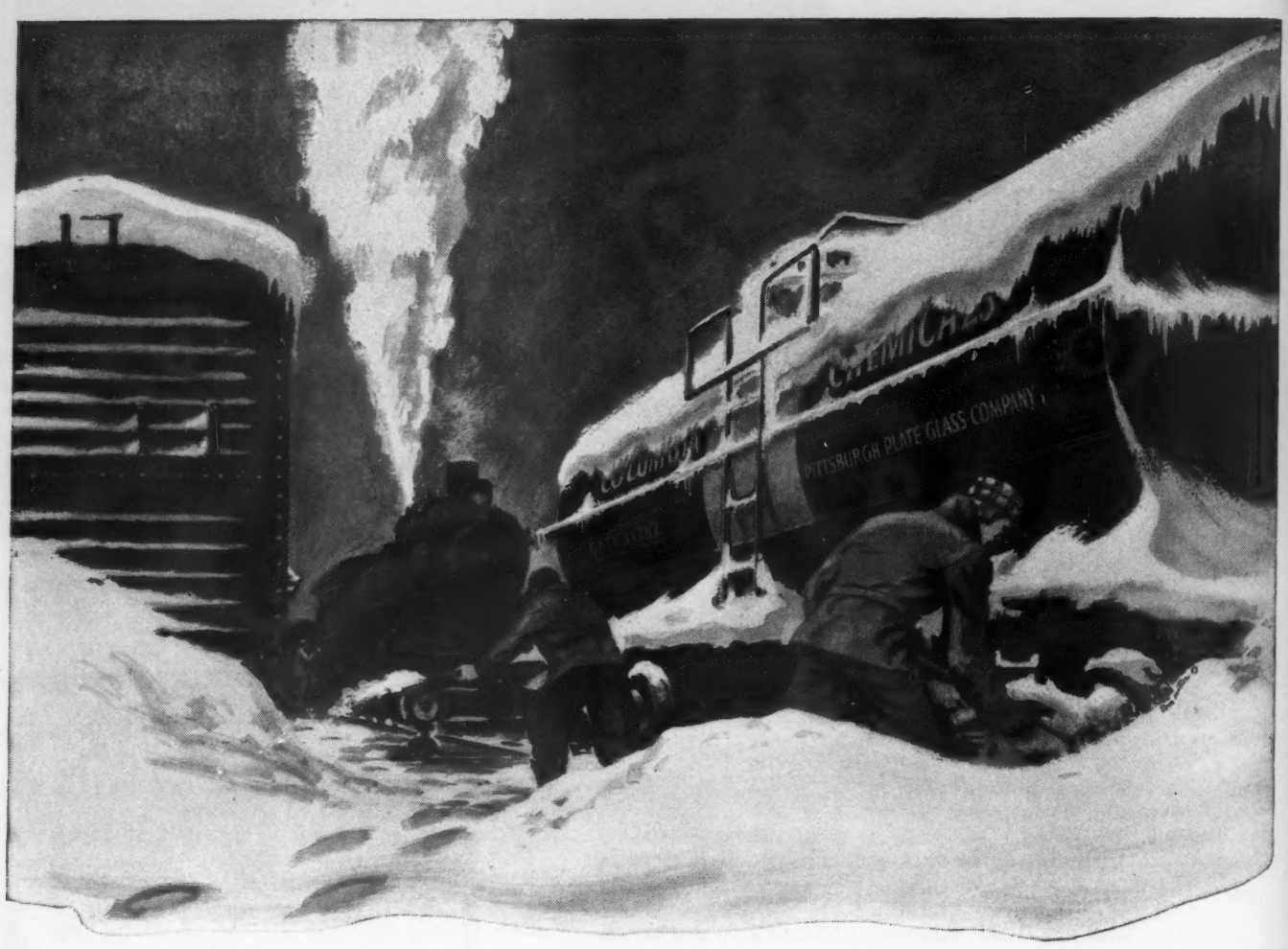

No Steaming Needed

—in spite of 21 days of rugged winter!

Columbia Caustic Soda Tank Car Unloaded Without Difficulty

On January 28, 1948, a Columbia Caustic Soda tank car left Barberton, Ohio, consigned to a Massachusetts plant. Heavy snow storms side-tracked the car near Buffalo. Transit time for this haul, ordinarily three to four days, stretched out to twenty-one days.

In spite of the long exposure to sub-zero weather, the temperature of the caustic liquor, loaded at 150°F., dropped only to 95°F None of the liquor had solidified and the car was unloaded easily and completely, without steaming.

Delays of this duration are rare. The incident therefore provides unusual evidence of the highly efficient design and construction of these cars—particularly in respect to insulation—and the rigid inspection and attention given to loading temperatures.

The same care is used in the manufacture and shipping of all Columbia products. Pittsburgh Plate Glass Company, Columbia Chemical Division, Fifth Avenue at Bellefield, Pittsburgh 13, Pennsylvania.

COLUMBIA CHEMICALS

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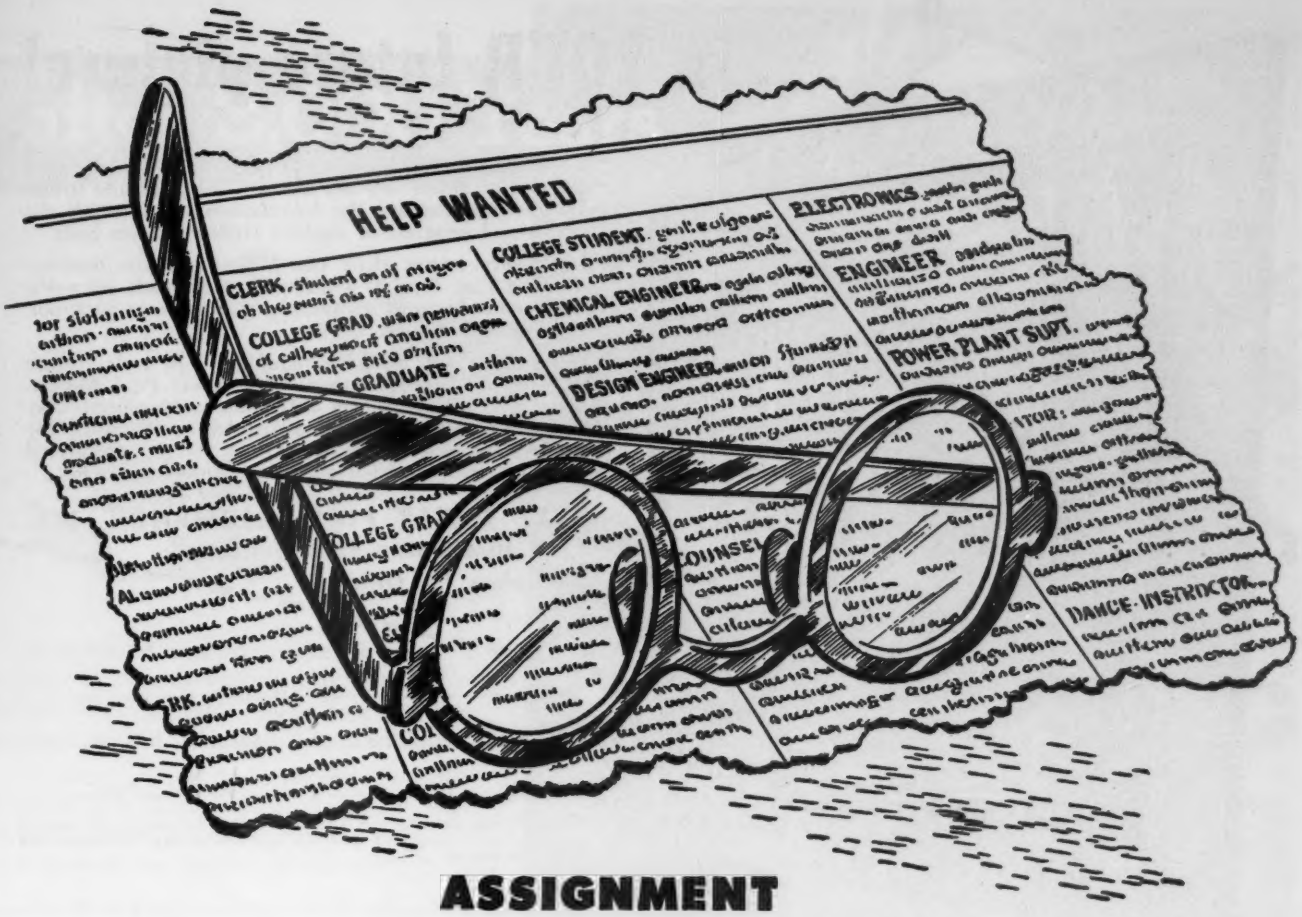
PITTSBURGH PLATE GLASS COMPANY



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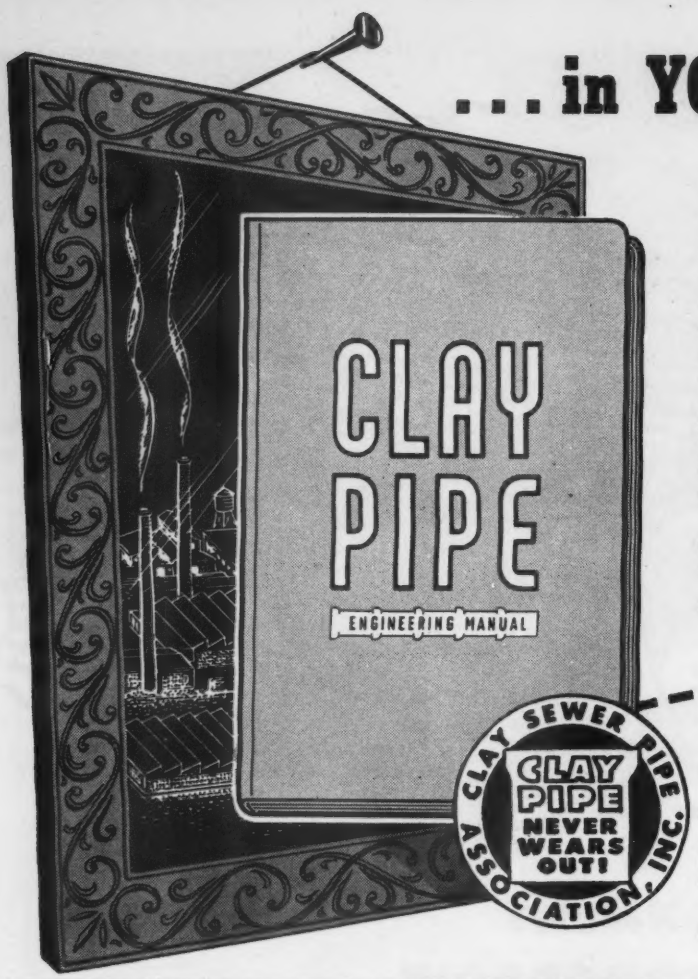

. . . in YOUR future picture!

Underlying great construction projects, "out of sight and out of mind," lay the sanitary sewerage and drainage systems that are the foundations upon which the health and progress of modern civilization are built.

Engineers know they can depend upon modern Vitrified Clay Pipe to withstand trench loads unknown a few years back, to withstand abrasion, resist corrosion and NEVER WEAR OUT!

If sewerage and drainage planning is in *your* "future picture", fill in the coupon. Clay Sewer Pipe Association, Inc., will send you FREE the only official Clay Pipe Engineering Manual available. It contains Clay Pipe application data to help you get the right start with the *right materials* on your engineering career.

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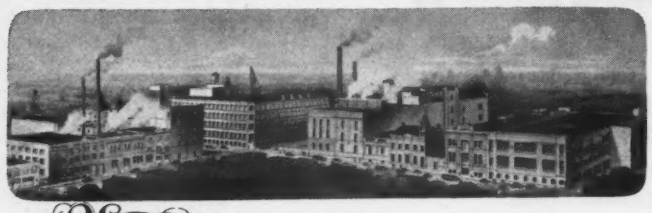
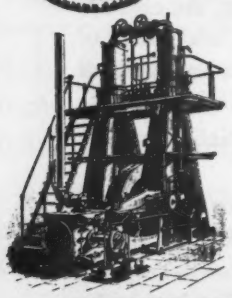
I certify that the above is a senior student in engineering studies leading to a career in engineering involving sewerage and drainage design.

Signature of Dean_____

CS-948-8



Hudepohl BREWERIES USE FRICK Refrigeration 60 YEARS!

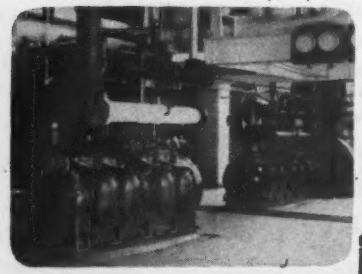


Frick ammonia compressors as built in the Eighties and Nineties were primitive machines by today's standards. But they were remarkably dependable: one of those installed in the Hudepohl Breweries at Cincinnati ran 57 years, another 52, and two others 45!

Naturally, Hudepohls believe in Frick Refrigeration. Their fine new engine room contains the two big Frick 4-cylinder machines illustrated.

You'll get the last word in reliability when you specify Frick Refrigeration. And you'll get equipment built to handle either ammonia, Freon, methyl chloride or carbon dioxide, to suit your special needs. All commercial and industrial sizes, 1/4 to 1000 horsepower. Let us quote on your requirements.

The Frick Graduate Training Course in Refrigeration and Air Conditioning, now in its 31st year, is approved under the G. I. Bill of Rights.



Old and New Types of Frick Machines at Hudepohl's

DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA. U.S.A.

that "wild blue yonder"

(*Continued from page 32*)

m.p.h., but you will not find many pilots willing to land that aircraft at anything less than 75–80 m.p.h. The wing will stall at 55 m.p.h., allowing you to land, but you do not want the wing to stall when you are twenty feet above the runway.

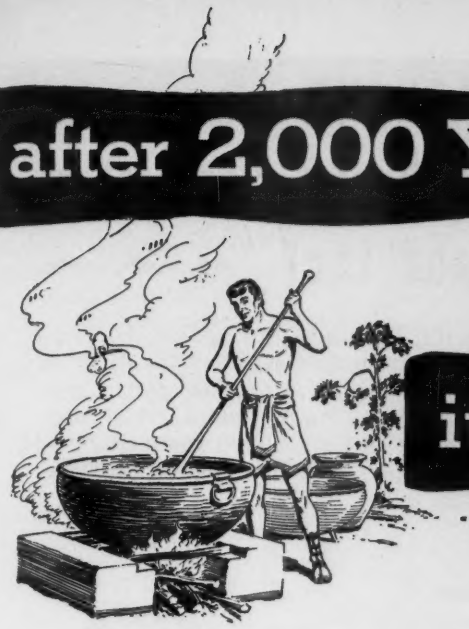
Helicopters are conspicuously absent from this review. Let it suffice to say that low-priced helicopters begin at $35,000 and that maintenance costs are very high.

No, that forecasted post-war airplane is not here. If there are any readers who are disappointed because it is not here, let them blame the advertisements and magazine articles they read during the war. The blame cannot rest on the aircraft manufacturers — no business man would make such predictions if he knew the capabilities of his own industry.

The reason those beautiful predictions did not come to be is simply because the aircraft industry is dependent on skilled workmen. An automobile body is stamped out on huge presses. An airplane fuselage is laboriously welded and riveted together by skilled workmen. A good rate of production is three airplanes a day — three airplanes that must bring in sufficient profits to pay those skilled workmen. If the production rate could be increased considerably, automobile type construction could be utilized in many ways, thereby cutting down on overhead and necessary profits. The future will bring low priced, luxurious airplanes to the public, but it is very doubtful that it will be in the near future. For the present, you will have to be content

(*Continued on page 38*)

after 2,000 Years . . .



it's out of the kettle!

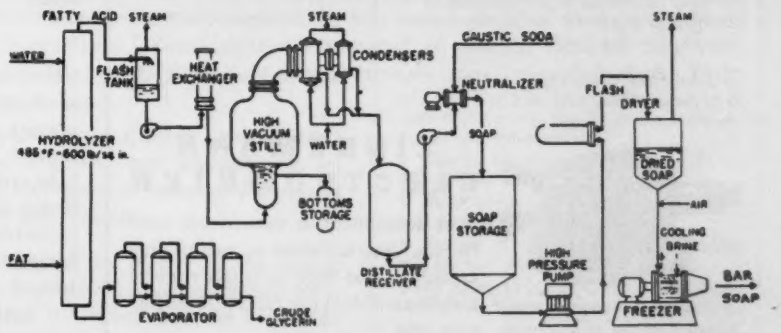
Since ancient times, ever since the discovery of soap, the making of this product has been strictly a "batch" affair. Even today, most factories still make soap in huge kettles.

Recently, however, technical men at Procter & Gamble have developed a revolutionary new *continuous* process for making soap. It starts in a hydrolyzer like the one pictured right.

The entire process, diagramed below, takes only a few hours, instead of the many days required by the old method. In addition to obvious savings, it also means improved products. To develop it, P AND G chemists had to pioneer uncharted fields—to solve many problems in the fundamental reactions of fats and oils; engineers had to design high-pressure equipment, high vacuum distillation and "flash" drying units, and lay out and construct new equipment, and entire new plants.

Now the process is in operation in many P AND G plants, with additional chemists and engineers supervising operation and personnel.

This is just one example of P AND G technical teamwork in action; similar developments progressing in other fields call for additional men with technical training. That's why P AND G representatives periodically visit the country's top technical schools to interview students. If you would like to talk to a P AND G representative, ask your faculty adviser or placement bureau to arrange a meeting.



PROCTER & GAMBLE CINCINNATI 1, OHIO

When FASTENING becomes your responsibility, remember this important fact — — —

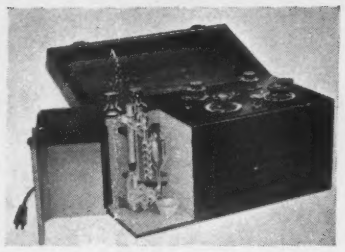
It costs more to specify, purchase, stock, inspect, requisition and *use* fasteners than it does to buy them. *True Fastener Economy* means making sure that *every* function involved in the *use* of bolts, nuts, screws, rivets and other fasteners contributes to the desired fastening result — maximum holding power at the lowest possible *total* cost for fastening.

You Get True Fastener Economy When You Cut Costs These Ways

1. Reduce assembly time with accurate, uniform fasteners
2. Make satisfied workers by making assembly work easier
3. Save receiving inspection through supplier's quality control
4. Design assemblies for fewer, stronger fasteners
5. Purchase maximum holding power per dollar of initial cost
6. Lower inventory by standardizing types and sizes of fasteners
7. Simplify purchasing by using one supplier's complete line
8. Improve your product with a quality fastener.

RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY
Plants at: Port Chester, N. Y., Coraopolis, Pa., Rock Falls, Ill., Los Angeles, Calif.

CAMBRIDGE electron-ray RESEARCH pH METER



RANGE AND ACCURACY: Sensitivity .005 pH; readings reproducible to .01 pH; accuracy .02 pH. Range 0 to 14 pH; 0 to 1200 M. V. *ELECTRON-RAY NULL INDICATOR:* Replacing the usual galvanometer, the electric eye provides quick and accurate null-point indication without possible damage to a delicate galvanometer. *NO BATTERY NUISANCE:* All-electric; plugs into any 110-volt AC Outlet. *ELECTRODE SYSTEM:* Sturdy glass electrode of condenser type is supplied. Micro or other glass electrode can also be furnished. *COMPACT AND PORTABLE.* Laboratory and Industrial Models also available. *Send for Bulletin 910 MA.*

3¼" x 2⅜" x 1⅜"
Weight 3½ oz.

LINDEMANN ELECTROMETER

This instrument is extensively used for the determination of radio active emission. Has high sensitivity, good stability and does not require levelling.

Send for descriptive literature

CAMBRIDGE INSTRUMENT CO., INC.
Pioneer Manufacturers of Precision Instruments
3756 Grand Central Terminal, New York 17, N. Y.

foreign student summer project—m. i. t.

(*Continued from page 24*)

brought together for the first time these students from fifteen countries so that they can learn to know each other.

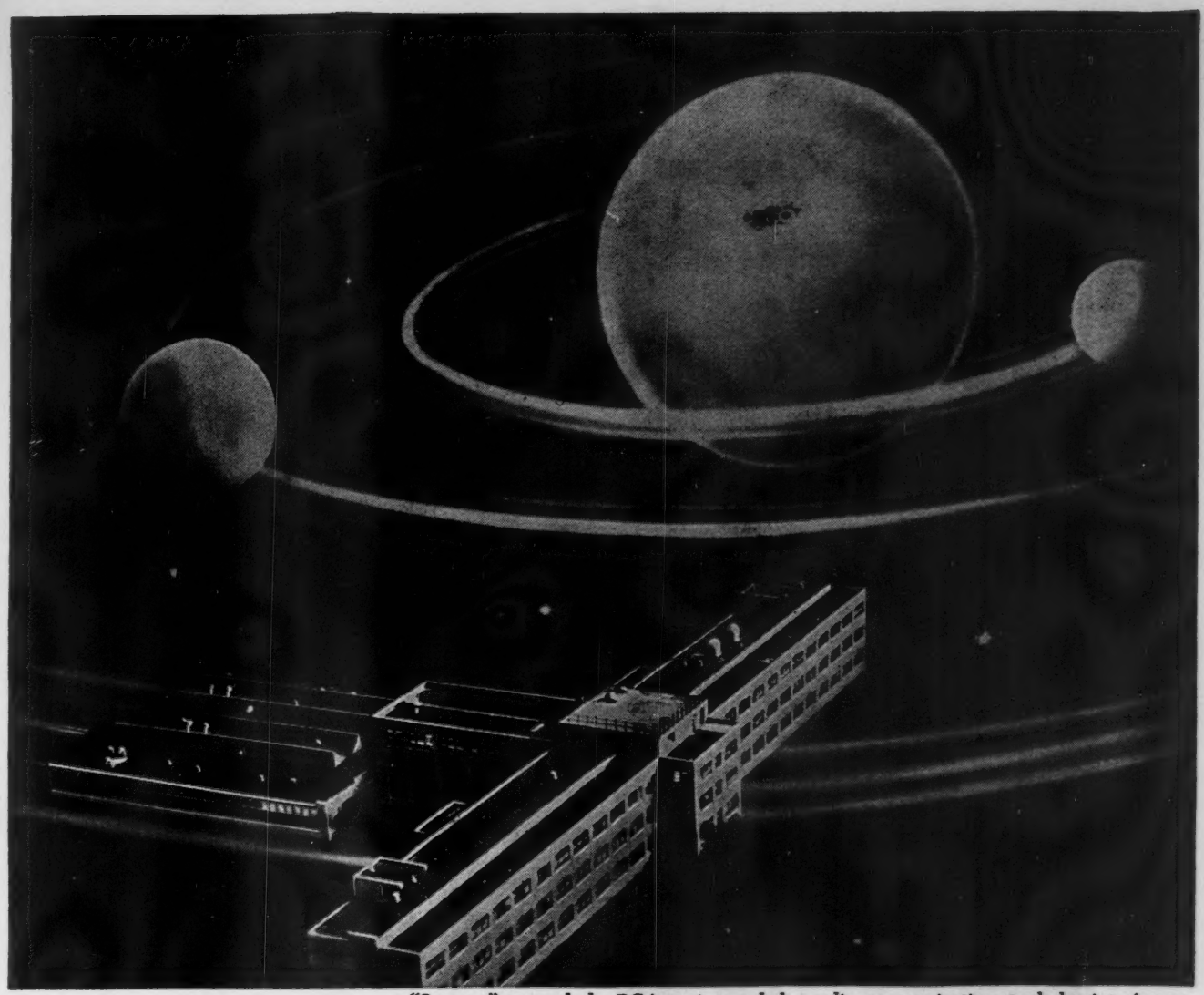
We hope that the M. I. T. Foreign Student Summer Project of 1948 will be the beginning of similar plans in other American colleges, where others, while they are still students, may share in the stimulating task of increasing understanding among the youth of the world.

that "wild blue yonder"

(*Continued from page 36*)

with an airplane featuring lots of built-in safety and pleasure. Through the next few years you will see airplanes entering the market that are full of improvements. A single place airplane using a Crosley automobile engine and selling for less than $1,600 is being test flown now. A fine four-place airplane selling for $2,400 is being readied for production today. Several combination automobile and airplane models are being tested and should prove very promising.

Some think that personal airplanes will not amount to much. You, the businessman of the future, may very likely find an airplane one of your most valuable assets. In the next few years there will be one prime consideration keeping you from flying — just how much do you want to fly?



"Sunspot" research, by RCA engineers, helps radio communications to dodge interference from magnetic storms. RCA Laboratories is a center of radio and electronic research.

93,000,000 miles of laboratory space

A cyclonic spot erupts on the face of the sun, and—here on earth—we feel it. Sunspots cause "magnetic storms," which disrupt radio communications.

What can be done about it? Research, during which RCA scientists and engineers "worked" by instrument on the sun—93,000,000 miles away—offers an answer.

For years, science related magnetic storms to sunspots. Accurate forecasts of disturbances were needed.

RCA scientists took a new tack. They noted that interference was most intense when sunspots were in a certain "critical area." Location and activity were observed to be more important than size.

Using this knowledge, RCA communications engineers accurately forecast the beginning and end of magnetic storms. They have established a daily magnetic storm forecasting service which is distributed like weather reports throughout the world. Transmission of messages can be arranged over circuits or paths that will dodge interference.

Such a pioneering spirit in research gives efficiency of service and leadership to all products and services bearing the names RCA, and RCA Victor.

• • •

When in Radio City, New York, be sure to see the radio, television and electronic wonders at RCA Exhibition Hall, 36 West 49th Street. Free admission. Radio Corporation of America, RCA Building, Radio City, N. Y. 20.

Continue your education with pay—at RCA

Graduate Electrical Engineers: RCA Victor—one of the world's foremost manufacturers of radio and electronic products—offers you opportunity to gain valuable, well-rounded training and experience at a good salary with opportunities for advancement. Here are only five of the many projects which offer unusual promise:

- **Development and design of radio receivers (including broadcast, short wave and FM circuits, television, and phonograph combinations).**
- **Advanced development and design of AM and FM broadcast transmitters, R-F induction heating, mobile communications equipment, relay systems.**
- **Design of component parts such as coils, loudspeakers, capacitors.**
- **Development and design of new recording and reproducing methods.**
- **Design of receiving, power, cathode ray, gas and photo tubes.**

Write today to National Recruiting Division, RCA Victor, Camden, New Jersey.

Also many opportunities for Mechanical and Chemical Engineers and Physicists.

RCA **RADIO CORPORATION of AMERICA**

SUPER TENSILE MUSIC WIRE PLATED WITH PURE GOLD...

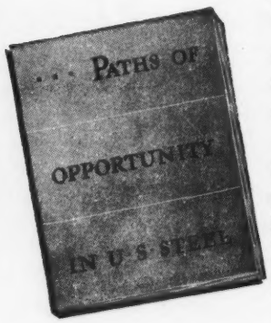
developed by American Steel and Wire Company

Tenor banjo and tenor guitar players have long been plagued by unsatisfactory "A" or first strings. This string, when properly tuned, is under such high strain that most wires barely reach pitch. At the request of the Mapes Piano String Company, the Metallurgical Department of the Worcester Works of the American Steel and Wire Company, a subsidiary of United States Steel, created, after months of research, a wire specifically for this purpose. This new wire is made so strong that it possesses more than twice the tensile strength, in pounds per square inch, of cross sectional area, of the steel wire which American Steel and Wire spun into cables to suspend the 8¼ mile bridge across San Francisco Bay from San Francisco to Oakland, California. This makes the new string the strongest wire of its size of any kind known today.

This high quality super tensile wire is produced by a special combination of heat treatments and exceptionally long and exacting cold working. The result is a wire of 0.010 gauge with a tensile strength of approximately 460,000 pounds per square inch. One pound of this wire extends 3749 feet, or sufficient footage to pass from nut to bridge on approximately 1500 banjos or guitars. This unusual wire is then plated with pure gold in order to prevent rust and to impart beautiful appearance.

Opportunities

This wire development is typical of the work being done in United States Steel Laboratories. But such research is only one kind of development to be found within the United States Steel industrial family. United States Steel and the steel industry are famous for development of men.



Have you seen our book "Paths of Opportunity in U·S Steel?" Ask your Placement Officer about it.

AMERICAN BRIDGE COMPANY · AMERICAN STEEL & WIRE COMPANY · CARNEGIE-ILLINOIS STEEL CORPORATION · COLUMBIA STEEL COMPANY
H. C. FRICK COKE AND ASSOCIATED COMPANIES · GENEVA STEEL COMPANY · GERRARD STEEL STRAPPING COMPANY
MICHIGAN LIMESTONE & CHEMICAL COMPANY · NATIONAL TUBE COMPANY · OIL WELL SUPPLY COMPANY · OLIVER IRON MINING COMPANY
PITTSBURGH LIMESTONE CORPORATION · PITTSBURGH STEAMSHIP COMPANY · TENNESSEE COAL, IRON & RAILROAD COMPANY
UNITED STATES STEEL EXPORT COMPANY · UNITED STATES STEEL PRODUCTS COMPANY · UNITED STATES STEEL SUPPLY COMPANY
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USS

UNITED STATES STEEL

The Miracle

you put on your eggs...

Just plain Salt! But what wonders it performs in the hands of expert chemists and engineers. Its two components play a big part in the production of paper, soap, glue, metals, metal products, textiles, insecticides. They help to sanitize water, launder clothing, kill bacteria in dairies, restaurants, food plants.

"Miracle-working" with Salt—as well as other basic chemicals—has been Pennsalt's business for 98 years. Starting with a modest plant at Natrona, Pa., Pennsalt has steadily grown, until today it stands as one of America's important chemical companies.

Big? Yes . . . but not so big as to swallow up its promising young men. Old? Yes . . . but not too old to adopt young ideas that are sound. Pennsalt was founded by a young man; and grew large through the efforts of young men.

The future, too, looks bright for Pennsalt . . . and for the young men who are going to build it. Pennsylvania Salt Manufacturing Company, Philadelphia 7, Pa.

PENN SALT

CHEMICALS

briefing the news

Quanta per Photographic Grain . . .

About forty of the tiny particles of light known as quanta, which travel about 186,000 miles a second, must strike a single photographic grain of silver bromide before it can be developed. This conclusion concerning the sensitivity of a silver grain to light is reported in the April "Journal of the Optical Society of America" by Dr. Julian H. Webb on the basis of recent studies in Kodak Research Laboratories.

Dr. Webb said that the total energy of the forty quanta, when transmitted in the average photographic exposure time of one one-hundredth of a second, is about two quadrillionths of a watt, an infinitesimal part of the energy required by an ordinary light bulb.

Photographic emulsions in general use have many silver grains suspended in depth. For his experiments, Dr. Webb used special plates made by diluting a regular emulsion and spreading it on optically polished glass until the emulsion layer was only one grain thick. He found the number of grains per square centimeter in these single-grain-layer plates by microscopic count and then exposed the plates to light of known energy.

Using the microscope again, further counts were made of the developed and undeveloped grains for successive steps in exposure. Information obtained was used to plot "characteristic curves" which show exposure and density of the number of developed grains. Further study was made statistically in an attempt to find the number of quanta actually used in the formation of the latent image.

Dr. Webb said that results indicate that probably not more than ten of the forty quanta absorbed by each grain are actually used in formation of the minute silver speck which is believed to start photographic development. Some of the quanta, he feels, may go to forming internal specks or in building up other small specks of silver scattered in the grain, none of which necessarily contributes to the "trigger" speck.

Plastic Roads . . .

Plastic roads created by advanced methods of soil stabilization are now realities, reported Dr. Hans F. Winterkorn of Princeton University to the American Chemical Society. By treating soil chemically, it is possible to produce low cost roads for rural areas which are as strong and as durable as those made of concrete.

This development came about as a result of research for World War II, in which these methods were employed for the construction of military airfields. Although large-scale plans in this country still concern the fairly distant future, Argentina has already formulated an extensive project to be begun soon.

Mechanical Properties of Human Bones . . .

Research with human bones by Frank C. Smith of the National Bureau of Standards has indicated that ordinary laboratory techniques and instruments may be applied to obtain much needed data on the mechanical properties of human bone — knowledge necessary in predicting body behaviour under impact loads as encountered in aircraft crashes, seat-ejection from aircraft, parachute opening, and exposure to blast.

Many instances are known of aircraft and other vehicles crashing to complete destruction, following which the occupants emerge from the wreckage miraculously unhurt. Conversely, a relatively slight blow to certain sensitive portions of the body may have serious and even fatal consequences. Since the human skeleton provides support for the body and protection for vital organs, it was decided to begin the study with an investigation of the mechanical properties of human bones and joints. Results are to be used in the design of simplified mechanical models of the human frame which will make possible an estimate of the forces set up in the body during impacts of various types.

The study was initiated with measurements of the mechanical properties of the structural members of the skeleton, beginning with the long bones, and was designed to establish average values on a statistical basis. The initial work involved seventeen tests on specimens made from bone of the compact type removed from near the middle of the bones of the extremities of humans and monkeys. Fourteen of these tests were made in compression with the direction of the load parallel to the fibers of the bone. One was made in compression with the direction of the load perpendicular to the bone fibers, one in bending, and another under torsion load. Test specimens consisted of sections removed from the bones and of portions machined into plates and hollow cylinders.

Given the specimen's average cross-section and the load, applied and measured in these investigations with a standard hydraulic-type testing machine, the stress

(*Continued on page 44*)

Another page for **YOUR BEARING NOTEBOOK**

How to keep a power shovel from digging its own grave

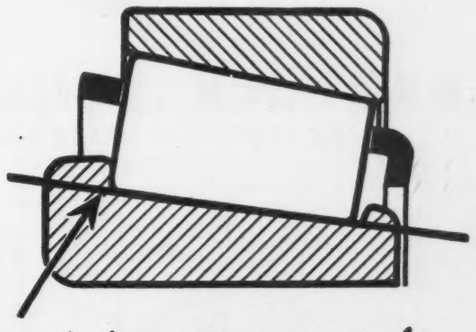
Power shovels and other heavy duty construction equipment take a terrific beating. And this used to wear them out at an early age. Today, engineers are building longer and longer life into the construction equipment they design by specifying Timken tapered roller bearings in place of the friction bearings formerly used.

Timken bearings make parts last longer by eliminating friction, by keeping gears meshing properly and by preventing vibration.

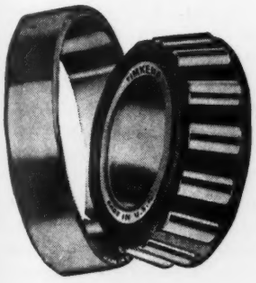
Why Timken bearings are first choice for heavy shock loads

Notice how the load on a Timken bearing is spread over the entire length of the roller instead of being concentrated at a single point. This reduces the unit pressure between the rolling elements.

This greater load area minimizes distortion of the bearing. Load capacity is increased, the bearing wears longer, and wheels and shafts are held rigidly in line. It's another big reason why 9 out of 10 bearing applications can be handled more efficiently with Timken bearings.



line contact provides greater load area

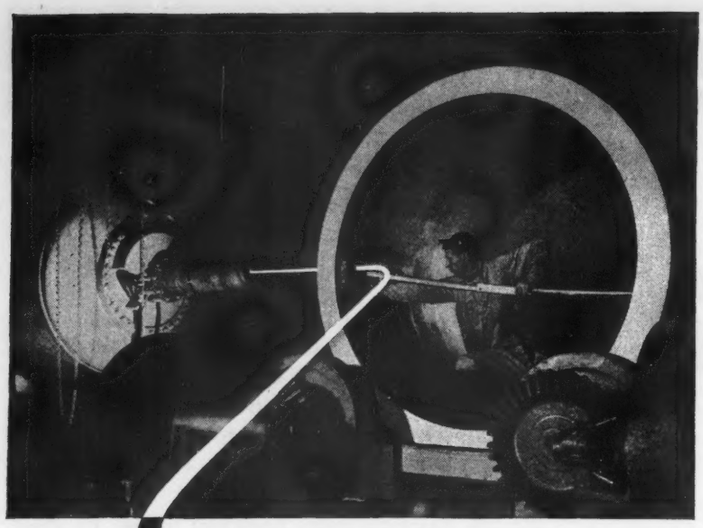


TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

Would you like to know more about bearings?

Some of the important engineering problems you'll face after graduation will involve bearing applications. If you'd like to learn more about this phase of engineering, we'd be glad to help. For additional information about Timken bearings and how engineers use them, write today to The Timken Roller Bearing Company, Canton 6, Ohio. And don't forget to clip this page for future reference.

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ◐ AND THRUST ⊣◐⊢ LOADS OR ANY COMBINATION ✳



The NEW LOOK—B & W Style

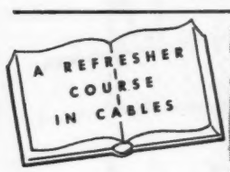
BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
85 Liberty Street, New York 6, N. Y.

Partially visible at far left is a new 2,000,000-volt X-ray machine at B&W for making certain that welded seams in pressure vessels for large boilers, refineries, and chemical processes meet industry code specifications. It is the largest X-ray ever built for this important purpose — eight times as powerful as the average hospital X-ray.

Long years of this kind of engineering foresight and initiative has linked the B&W name with numerous other significant pioneering advances in many fields of industrial activity.

Yet for all its 80 years, B&W has never lost the art of having new ideas —a good reason why technical graduates can look to B&W for excellent career opportunities in research, engineering, production, sales and other vocations.



THE SOURCE OF A RIVER IS THE SOURCE OF

QUALITY

. . . From the headwaters region of the Amazon comes Up-River "Fine Para", widely acknowledged by rubber experts as the highest grade of natural rubber. *To Okonite researchers and independent experts alike,* long experience has shown that only this rubber provides all the factors needed in top quality insulation for electrical wires and cables.

The Okonite Company obtains a high degree of uniformity in shipment after shipment of this premium rubber in "biscuit" form . . . has found that Up-River Fine Para assures a long service life . . . uses it exclusively in all Okonite rubber insulated wires and cables. The Okonite Company, Passaic, New Jersey.

6964

OKONITE SINCE 1878

insulated wires and cables

briefing the news

(*Continued from page 42*)

on the specimen may be computed from elementary formulas of strength of materials. The strain in the bone specimens was measured with wire resistance and Tuckerman optical strain gages to an estimated accuracy of 0.000002 in./in. Stress-strain, flexure, and torsion curves plotted from the test data reveal an interesting and significant factor regarding such properties of human bones. The curves are found to lie in approximately straight lines up to failure, thereby simplifying the analysis of the mechanical behaviour of the body structure. This means that the load-displacement relations for human bones may be approximated by simple linear equations.

The results of the tests showed the average ultimate strength of the fourteen compression specimens to be about 23,000 lbs./sq. in. The fifteenth specimen, in which the load was applied at right angles to the bone fibers, had about the same ultimate strength, indicating that the effect of the direction of loading on the bone is small. The strength of the bone in bending, i.e., extreme fiber stress at failure, was slightly lower than the strength in compression. The computed ultimate shear stress for the torsion to failure was about fifteen per cent of the compressive strength.

These preliminary data indicate that bone may be considered an elastic, brittle material, having about one-fourth the compressive strength of cast iron and more than twice that of hickory wood. The average Young's modulus of elasticity of the bone, about 2.8 x 10^6 lbs./sq. in., is approximately one-tenth that of steel and about equal to that of wood.

"—The investigation of nature is an infinite pasture-ground"— T. H. HUXLEY

Food—ours to have and to hold

QUICK-FROZEN or in cans, dried or powdered, processed or in bulk, foods can now be kept fresh and flavorful from harvest to harvest . . . or longer.

For this we can thank research . . . and *better materials.*

There's nitrogen, for example, that protects the flavor and nutritional values of packaged foods. It is also used to protect delicate foods . . . butter and vegetable oils . . . keeping them sweet and free from undesirable odors.

Plastic-lined cans resist food acids and alkalies for months on end. They eliminate all contact with metal . . . and thus serve as an added guard against flavor contamination. Plastic-treated milk bottle hoods keep pouring surfaces sterile-clean . . . and new plastic containers, tough and pliable, "seal in" food's flavor and freshness.

Stainless steel, too, easily cleaned and sterilized, gives us spoilage-free tanks, vats, hoppers, filters and great kettles that help prepare and process food for our use.

The people of Union Carbide produce many materials essential to the growing, handling and preservation of foods. They also produce hundreds of other materials for the use of science and industry, thus helping maintain American leadership in meeting the needs of mankind.

FREE: *You are invited to send for the new illustrated booklet, "Products and Processes," which shows how science and industry use UCC's Alloys, Chemicals, Carbons, Gases and Plastics.*

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. . . a great name in research with a big future in **CHEMISTRY**

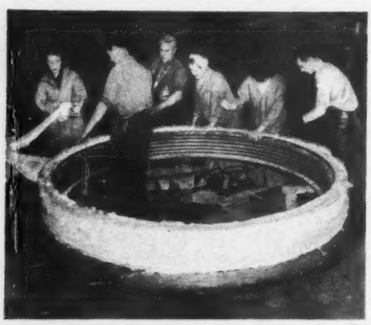
PLASTICS—INFANT INDUSTRY THAT GREW UP FAST

Ten years ago the infant plastics industry was teething. It has since rushed through a precocious childhood and grown to a vigorous and impressive maturity. Today the plastics industry is a multimillion-dollar business. Two-thirds of all American factories use plastics materials in their manufacturing operations.

Of course, plastics were not new ten years ago. In fact, back in 1894 General Electric was making lamp carbons out of an early plastic—lampblack-impregnated potter's clay.

New Materials Encourage Growth

But the rapid growth of the plastics industry came in the late 1930's when new materials and improved molding techniques encouraged its expansion. Then, with World War II, plastics manufacturing accelerated tremendously.



Synchrotron ring, molded by G. E. for Univ. of California's new betatron atom-smasher.

General Electric's position in the plastics field is unique in that G. E. is the world's largest manufacturer of finished plastics products and also a manufacturer of molding powders.

General Electric offers a complete plastics service. It has facilities for developing special compounds and for designing, engineering, and molding plastics products to meet individual customers' requirements.

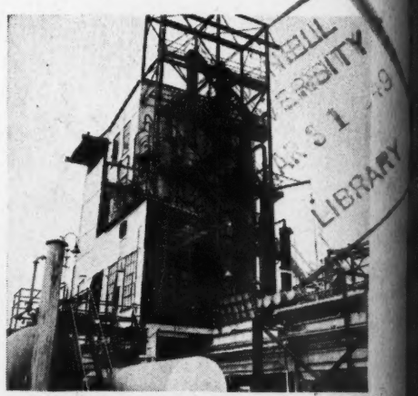
The variety of parts and products turned out by General Electric's Plastics Division is startling—and it illustrates the diversity of applications that are being found for plastics in the postwar world.

For Rowboats and Radios

Take, for example, the plastics dinghy. This is a four-passenger boat molded of laminated plastics by General Electric for a New England boat manufacturer. Then there is the synchrotron ring for the University of California's new betatron atom-smasher. It's the largest single part ever molded by G. E. Less spectacular, perhaps, but still important, are the hundreds of more familiar plastics products like clock cases, compacts, radio cabinets, camera cases, packages of all sorts, Textolite surfacing material, plastics parts for automobiles, refrigerators, and other appliances—even plastics cups for milking machines.

This plastics dinghy was molded by General Electric for the Beetle Boat Company.

Since 1920, General Electric has manufactured molding powders for its own use. Recently, a synthetic phenol plant was completed in Pittsfield. As a result of this increased production capacity, G. E. can now provide high quality phenolic compounds to other molders.



New G-E Phenol plant at Pittsfield, Mass., showing fractionating towers on distillation building.

General Electric's plastics activities are just one phase of the operations of the Chemical Department, where research is opening new doors to progress. In the fascinating new field of silicone chemistry, in resins, in insulating varnishes, in permanent magnets, General Electric is making contributions to chemical knowledge. For more information on any of these activities, write *Chemical Department, General Electric Company, Pittsfield, Massachusetts.*

A message to students of chemistry from

DR. J. J. PYLE

Director, General Electric Plastics Laboratory

The field of plastics is surely a stimulating one—and one that offers many opportunities and the utmost in challenge to graduate chemists and chemical engineers. At General Electric, plastics research is presenting new possibilities in this fascinating field that should prove exceptionally interesting to young technical men.

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